The science news monthly

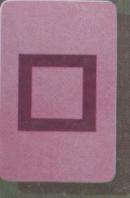
# SCIENCE DIGEST

**NOVEMBER 1965** 

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Britain from Egypt in about 1870.

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What science discovers today determines how we'll live tomorrow. That thought was brought home to us in the past few weeks as we read letters from readers reacting to our August article by Isaac Asimov, Life in 1990.

We thumbed through issues of Science Digest for 1940 for clues to how we'd be living 25 years thence—meaning today. They're commonplace enough subjects now, but the following articles in 1940 reported three developments that at the time seemed almost fantastic:

## THIS MONTH

Possible Fabulous Power from Uranium (July, 1940, page 83).

New Process to Moth-Proof Wool (August, 1940, page 95).

Sulfanilamide, Master Germ Killer (September, 1940, page 42).

And the October, 1940, issue pointed out that the general reader had first read about nylon, lucite, plant hormones and hybrid corn in *Science Digest*.

Maybe 25 years from now someone will point to a report in this issue as a landmark in the dissemination of new scientific knowledge.

(Confession: In May, 1940's Science Digest, a Harvard professor said the U.S. would reach its maximum population about 1970 and that the total would be "little more than 150 million souls." Well, on August 26, 1965, the U.S. became a nation of 195 million. Oops!)

-THE EDITORS

## SCIENCE DIGEST

The basic tool of ESP research is a pack of 25 cards each imprinted with one of five simple symbols (right). They were developed by Drs. J. B. Rhine and Karl Zener of Duke University in 1930. For a special report on where the controversial study of ESP stands today, turn to page 62.

Painting by George Kelvin Cards © J. B. Rhine



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## THE LATE SCIENCE NEWS

HALFWAY TO THE MOON. Dr. Wernher von Braun said the U.S. program to land a man on the moon before 1970 is more than 50 percent complete. The man in charge of building the Saturn moon rocket that will send the Apollo spacecraft on its journey reported that "most of the facilities required for Apollo are operational, and those still under construction are nearing completion."

RUSSIA AND THE MOON. Soviet Academy of Sciences president Mstislav V. Keldysh said it isn't possible yet to say when man will get to the moon. We don't yet know enough about the moon's surface, he said, to decide on a place to land. Meanwhile, Dr. B.J. Levin of Moscow's Schmidt Institute of Earth Physics reported evidence that the interior of the moon is four or five times as radioactive as the earth's and is liquid. Fellow scientists who heard his paper at a Caltech conference viewed his conclusions skeptically. The radioactivity count was based on observation of lunar radio emissions, which indicated a rapid rise in temperature at relatively shallow depths. Significance of the finding, if true: Maybe the moon was torn from the earth, whose crust is much more radioactive than its core.

COMING: A LUNAR SOFT LANDING. That was the good news inferred from a perfect Atlas-Centaur shot of a metal Surveyor model. An actual Surveyor may land on the moon before year's end to analyze lunar "soil" samples.

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MORE ABOUT MARS. The idea of "canals" on Mars was revived. British astronomer Eric Burgess saw a streak 30 miles wide in photo No. 11 taken by Mariner 4. He said the "canals" may actually be rift valleys.

AMERICA'S SPACE GOALS. President Johnson spelled them out in announcing the order to start construction of a military Manned Orbiting Laboratory (see page 16): "This program will bring us new knowledge about what man is able to do in space. It will enable us to relate that ability to the defense of America." But he said the U.S. will "live up to our agreement not to orbit weapons of mass destruction." We also want to cooperate with all in space, he declared, "including the Soviet Union." And he invited a Soviet observer to the launching of Gemini 6. Russia declined the invitation. Some observers saw the MOL order as the start of an arms race in space, though no aggressive advantage is now evident.

MORE FRESH WATER FROM SALT. Johnson called on industry, science and universities to join the Government to build enough desalting plants by 1970 to provide 100 million gallons of fresh water a day.

SECRET SUBMARINE DEFENSE. Newspaper reports disclosed the operation of an elaborate submarine detection system off the U.S. Atlantic coast. A chain of hydrophones has been set along the continental shelf. Sounds picked up by several hydrophones (underwater microphones) are processed by computer. The system is said to distinguish the sound of a sub from the ocean's "background noise."

OR A LONGER LIFE. President Johnson signed bill providing \$280 million for health research and another extending grants for mmunization. In 10 years, he declared, the J.S. would strive to add five years to our average life expectancy. It's now 70.

LEUKEMIA DISCOVERY. An NYU researcher studying a family with a high incidence of leukemia found a significant clue: The granddaughter of the first victim and two of her
three children had an excess of white blood
cells, all leukemic and also with broken
areas on the 21st chromosome. Hypothesis:
an insidious agent, probably a virus, invades the nucleic acids of the chromosomes!

ASTRONAUT TAKES TO THE DEPTHS. M. Scott Carpenter, an astronaut from the days of the Mercury flights, went down instead of up. With nine other aquanauts, he descended (above) into the Pacific off La Jolla, Calif., to test man's ability to withstand prolonged stays underwater. Their home: a three-room apartment in the shape of a stubby cylinder 205 feet beneath the surface. Sealab II's interior had a pressure a little higher than the water pressure outside, so that the aquanauts' home had an open four-foot hatch in its floor, through which they came and went at will, without fear of Sealab's flooding. Their air: 85 p.c. helium, 11 p.c. nitrogen, 4 p.c. oxygen. After two weeks, nine came up, weary but well. Carpenter stayed on for a scheduled two weeks more of aquanauting.

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HOPE FOR Rh BABIES. Three scientists from New York's College of Physicians and Surgeons foresaw better treatment of Rh babies and possible prevention of the condition. Their goal: "vaccination" of Rh-negative women against Rh-positive blood so they won't produce antibodies against it that affect their Rh-positive babies.

CANCER, HEART DISEASE, PSYCHOSIS. Medical researchers came up with four noteworthy statistical findings: 1. Lung cancer fatalities, according to WHO, have shown an "alarming increase" in Europe and North America. 2. Mouth and throat cancer, according to a study in New York hospitals, are linked to heavy drinking. 3. People who have smoked heavily for a long time, according to two VA physicians in Seattle, may be more likely to develop cancer of the bladder. 4. Heart surgery patients, according to New York's College of Physicians and Surgeons, often suffer temporary psychosis.

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RAYS FROM SPACE. 1. A committee in Cairo is studying a plan to unveil the secrets of the pyramids of Giza by placing cosmic-ray detectors beneath them. Measuring the rays should reveal the presence of possible hidden chambers. 2. For the first time, a Case Institute physicist in a S. African mine detected natural neutrinos, the most elusive of all known particles of matter.

QUOTE OF THE MONTH: "We may be no further today from at least partial synthesis of living systems than we were in the 1920's from the release of nuclear energy or in the 1940's from a man in space. The job can be done—it is merely a matter of time and money."—DR. CHARLES C. PRICE, President of the American Chemical Society.

## REPORT OF THE MONTH

## Brains without bodies



—that will be the ultimate outcome of a fascinating series of studies and experiments to synthesize man's nervous system

by Bruce H. Frisch

Is your computer lazy? Does it give up too easily on tough problems? Dr. Peter Kelly, director of Philco's Advanced Technology Laboratory, has a disturbing solution: Plug in a living brain to give it motivation.

No, we are not there yet, but scientists are already putting the electricity of the nervous system in control of machines. They have started at the fingertips, and are working toward the brain.

The trend began in World War II when so many men lost parts of their limbs. The new legion of amputees spurred the development of artificial hands and arms to a high state of refinement. But basically they remained the same. A cable ran from a harness around the shoulder to a hook. A shrug of the shoulder closed the hook, and with some arms, bent the elbow.

Then, in the 1950's, the arts of prosthetics (artificial parts) and orthotics (aids for paralyzed limbs) broke into new territory—power.

The action of a real muscle was closely duplicated by the McKibben muscle developed at Ranchos Los Amigos Hospital in Los Angeles. Braided nylon covered a rubber tube. As high pressure gas inflated the tube, the nylon cover shortened. A five-inch-long McKibben muscle one half-inch in diameter pulled with a 90-pound force.

Pistons in cylinders took over most jobs, however, because they could handle higher pressures that gave more power for less weight. A cylinder about the length and thickness of a man's thumb exerted a 50-pound force.

In recent years, lightweight battery-powered systems for space have given electricity an edge over gas. The latest arms run on small, high-speed, direct-current motors driving screwjacks. Two arms can run 14 hours on 12 ounces of nickel-cadmium batteries.

The powered arms could do a lot more than the old shoulder-shrug hook. One arm made by the American Institute for Prosthetic Research had nine different back-andforth movements. This raised a new problem: How to control it?

All kinds of things were tried. Muscle bulges, chest or abdominal expansion, shoulder-blade spreadall were rigged to nudge tiny valves or microswitches. In one case, a man was outfitted so that as he rotated the bump on the end of his shoulder, he worked a four-position valve. The absolute end may be the system worked out by Case Institute of Technology in Cleveland. Evebrow movement controls four arm motions. Both eyebrows raised in surprise is one; both lowered in a scowl, a left wink and a right wink are the others.

The trouble is that anyone who can stick out his stomach, look surprised, spin his shoulder and inhale at the same time is a virtuouso. Surgeons found that an amputee who wasn't fitted with an artificial arm within 18 months learned to be one-armed. He would no longer take the pains to learn a complicated routine, but would wear the arm just for appearance.

In addition, the control movements were completely unnatural. Surgeons tried putting amputees' remaining muscles back in use. Almost all the muscles to control the hand are in the forearm. Those to control the forearm are in the upper arm, and those moving the upper arm are in the shoulder. A man who has lost his forearm still has the muscles to move it. So the surgeon would slit the biceps, line the slit with skin and imbed a peg in it. By pulling on the peg, the amputee could either bend an artificial elbow directly or control a powered one. Cineplasty tunnels, as the slits were called, were hard to keep clean and often became infected. Today they are seldom done in this country.

#### **Electrical** control

The basic idea was a good one-controlling an artificial arm with the same muscles that controlled the natural arm. By the mid-1950's, scientists in Yugoslavia, Russia, Britain and the U. S. were experimenting with tapping the electricity of these muscles for control.

A chemical reaction carries a pulse of electricity from the brain down the spinal cord and out a motor nerve to the muscle. The nerve branches at its end to meet as many as hundreds of muscle fibers. The pulse jumps the gap and travels down each fiber. A few thousandths of a second later, the fiber gives a single twitch. A single nerve and its muscle fibers are a motor unit. To pull harder we send more pulses as well as fire more motor units.

Two silver electrodes the size of shirt buttons taped over the muscle can pick up the pulse. The voltage of the electromyographic (EMG) signals is in the neighborhood of one-tenth volt and is roughly proportional to muscle tension.

In 1955, British workers had come up with a hook powered by an electromagnet triggered by muscle voltage. As the amputee squeezed his phantom hand, the muscle voltage rose until it tripped the electromagnet which snapped the hook shut. When he completely relaxed,

the hook sprang open.

The successor to this hook is the best of several EMG-controlled hands now in existence. Dr. Alastair Bottomley and Terence Cowell of St. Thomas's Hospital, London, tape one pair of pickups on the underside of the forearm over the flexor muscles which close the hand, and another pair on the top of the forearm over the extensor muscles which open the hand. The difference in the two voltages controls the closing speed. After the hook grips, the voltage difference

The Army's Pedipulator will mechanically mimic the motions of the operator inside.



controls the hand's squeezing force.

A similar idea has been applied to an elbow by a team of surgeons from Liberty Mutual Insurance Company and engineers from M. I. T. They matched biceps and triceps voltage to grade both bending speed and lifting effort.

## Loud, clear signals

Signals from two widely separated muscles come in loud and clear. Those from lavered and intertwined muscles merge into a cocktail-party-like chatter from which no one voice can be picked. Walter Wasserman and his staff at the Philco Bio-Cybernetics Laboratory reasoned that a trained ear should be able to catch a subtle shift in the tone of the hubbub as groups of muscles performed different motions. They recorded EMG patterns produced by six muscles in the shoulder and fed them to a computer which learned to distinguish between movements. This recognition was built into simple, miniature electric circuits.

Philco first applied this technique to a simple problem. An arm amputated just above the elbow still has two of the three muscles that twist the wrist. By channeling four electrodes on the upper arm through recognition circuits, Philco built an arm that swivels at the wrist and bends at the elbow.

Hooked up to a non-amputee, the circuits can recognize upcoming moves long before the arm can carry through. In hot fighter

planes, the pilot could be rigged for EMG control, saving this reaction time.

The Yugoslavs have built electrodes into eyeglass frames, so that the EMG of the eyebrow muscles will activate power brakes. The time to apply the brakes is cut 75 percent.

Philco's patron, the Office of Naval Research (ONR), has ambitions far beyond power steering or prosthetic arms. At the same time, it has been financing the design of an exoskeleton by Cornell Aeronautical Laboratories. The exoskeleton is a 34.6-pound metal framework that straps around a man's arms. legs, chest and hips. ONR is now taking bids on the job of joining EMG control to the exoskeleton to make a man amplifier. Controlled by EMG signals, the powered exoskeleton would follow its wearer's movements and make him three times stronger. A man could become a human fork-lift truck in remote areas. A space explorer could fight the gravity of Jupiter, which would pull on him two and half times harder than Earth's. The moon's gravity is weaker than Earth's, but an astronaut may need a man amplifier to overcome his pressurized space suit.

#### Pedipulator

On a larger scale, the General Electric Advanced Technology Laboratory is building an 18-foothigh robot called Pedipulator. The robot will mimic the movements of



Controlled by muscle electricity, a powered exoskeleton will triple man's strength.

a man standing inside. Although control is by mechanical followers based on inventor Ralph Mosher's remote-controlled hands for atomic energy work, Pedipulator seems a cinch for EMG. The Army is paying the bills on the bet that a walking robot can pass where a truck or tank would bog down.

Mosher's biggest contribution is the sense of touch with which he has provided Pedipulator's master. Without it, Pedipulator would fall flat on its face. The followers that pick up the operator's movements also relay to him on a reduced scale the resistance met by the robot's limbs.

An amputee, like a steam-shovel operator, depends entirely on sight. If he closes his eyes, he can't tell where his arm is or what it's doing. ONR has sponsored research at the U. of Virginia that could be used to

feed an amputee this information. Vibrators against the skin use codes based on intensity, duration, location and other variables. It is even possible to point a direction. If a vibrator on the right side goes off about one-tenth of a second before one on the left side, it feels as if a finger were drawn across the stomach from right to left. One man, wearing five vibrators on his chest, learned to take as many as 38 sensory code messages per minute.

#### Puzzling questions

So far, we can't control machines from farther up the nervous system toward the brain. Muscle fibers are fat and numerous. They amplify nerve signals. Pulses from an individual nerve get lost in a noisy background chatter from other nerves and muscles nearby. Once a single nerve fiber is laid bare and pinpointed with an electrode needle, we are not sure what its signal means.

The electrical language of the brain is still more mysterious to us. Yet a few explorations have been made. Westinghouse tried translating brain waves for possible brainto-brain communications, but gave it up.

At the Air Force Cambridge Research Laboratories, Dr. Edmond Dewan actually sent crude messages with brain waves. Electrodes taped to the head pick up strong, slow (10 cycles per second) pulsations called alpha waves when we are daydreaming, and weaker,

faster, irregular waves when we are alert. Dewan closed his eyes to turn on his alpha rhythms, and opened them to turn them off. Electrical circuits attached to the electrodes sensed the difference and blinked a light or sounded a buzzer. Dewan and friends sent messages in Morse code at the rate of a letter every 20 seconds. He figures that almost any other method of communication is better. At one time he thought paralyzed stroke victims might talk this way, but he found that no one is paralyzed so completely that he can't twitch some muscle to relay messages more efficiently.

### Heart pacer

We are also beginning to put electrical signals into the nervous system. The heart pacer is an example. Along this line, Case Institute is working on sending the EMG signals from shoulder muscles to activate finger muscles that are intact but lack nerves.

Sensory input directly through nervous electricity is particularly crucial to Kelly's motivated computer. Kelly points out that brain in a computer could make abstract judgments. To make decisions it will need information. Any further progress in putting the nervous system directly in control of machines will probably depend on sending it sensory feedback. But once the machine starts sending signals to the brain or to the muscles, the question comes up: Who's controlling whom?

## THE SPACE PICTURE

## Man can adapt to space

PROLONGED flight in space won't hurt man. That's the tentative medical verdict after the record eight-day Gemini 5 flight of Gordon Cooper and Charles Conrad Jr. Though the astronauts chafed a little in the confined quarters, they were "in wonderful shape," said Dr. Howard A. Minners, recovery team physician, after their splashdown.

Both astronauts were tired. Curiosity had interfered with slated sleep periods. "Doggone it, during the day sides, you'd be trying to sleep and you'd just invariably start looking out that window at some of those places and you'd wind up never sleeping because you hated to miss anything," reported Col. Cooper.



Astronaut Gordon Cooper (above) swings up from Gemini 5 spacecraft in a sling to

the recovery helicopter after splashdown. Charles Conrad Jr. (left below) and Cooper, dubbed the "space twins," found space "the prettiest thing" they had ever seen.







Engineers double-check equipment on NASA's Orbiting Solar Observatory before it carried nine instruments into space.

This 106-foot rocket, Europa One, will be fired in April. The satellite-bearing rocket is a project by 7 European countries.

President Johnson has announced the first U.S. manned military spacecraft, the Air Force's MOL, will be launched in 1968.







Flames and smoke, controlled despite appearances, belch from a 2½-minute ground test of NASA's Saturn V rocket booster.



A highly adult version of the balloon, Pageos satellite stretches to 100 feet in diameter. Like Echo I and II, it will be a pinpoint of light used to find geographical points on the Earth's surface. Its orbit will put it 2,300 miles above Earth after launching next year.

## INSIDE PSYCHIATRY TODAY

## **Psychiatrists**

## analyze the Los Angeles riots



A National Guard jeep patrols 103rd Street in the Watts section after more than 30 persons died in the riots. Police and 2,000 Guardsmen finally quelled the mobs.

by Flora Rheta Schreiber and Melvin Herman

THEN violence erupted in the streets of Los Angeles recently, it appeared that the whole Negro population of the Watts section had joined in rioting, pillage and arson.

But, according to many on the scene, only a small fraction of the population rampaged and looted.

Dr. George J. Wayne, a Los Angeles psychiatrist, in an interview with Science Digest, said there was an actual tearing away of masks during those four days of terror that revealed the ugliness of those members of society who are never too sure of their own personal controls under the best of conditions.

What happened was not a civil rights parade, or sit-in, nor was it part of an organized movement. Instead, it was a spontaneous eruption initiated by a miniscule criminal element, perhaps two percent or less of the Watts section Negro population. This criminal element neither thinks nor acts in behalf of causes. Each member has the kind of conscience, says Dr. Wayne, that does not prevent antisocial behavior. He lacks the super-ego that creates a sense of guilt. Dr. Wayne adds, "This criminal element is by no means unique to Negroes. Every ethnic group has a small criminal group with a character structure permitting violence."

The psychopathology of initial outbreak of the Los Angeles violence is no different in dynamics than it would be if Negroes were not involved. The essential ingredient is a character make-up that permits violence. Dr. Paul H. Wilcox of Michigan said at a symposium held by the Medical Correctional Association, "The law of the control of the unconscious mind reads like this, 'Thou shalt not do this or that,' but it puts in something the Bible leaves out, namely, 'Unless you have a good excuse.' Thus the unconscious mind seems to be looking for excuses to let out its drives, including the drive to kill."

The Watts "acting-out" took place on a world stage, but it is related to what occurs less conspicuously in a brutal gang mugging or when a husband beats his wife.

## **Prolonged frustration**

Some of the rioters were new arrivals in Los Angeles from the Deep South, many were unemployable in the industrialized city and could not integrate into the Negro community. Dr. Wayne described them as persons reacting to prolonged frustration. They had transferred their hatred of authority to Los Angeles, a relatively "good" city. They struck out violently at the target in sight, perhaps not the one they hated most. They illustrate what Dr. Walter Bromberg of New York refers to as a maniclike psychosis, initiated by rage over severe frustration in many different types of people. He adds that "this condition may be an extension of the common episodic states observed among incarcerated prisoners, called stir-bug or stir-crazy."

## Theory of violence

In attempting to postulate a theory of violence, Arthur W. Hoffman, Illinois state criminologist, said, "Violence must be viewed as containing whatever attributes the subject possesses (his physical and mental qualities, including the tensional and emotional reinforcements) and the discerned objectives. Group violence involves all these individual elements and, in addition, supplies justifications, incentives, organized strength and opportunities for acting in crucial situations with one's fellows or peers."

Hoffman added, "If, therefore, it be said that violence, instead of being instinctive, arises because of a frustrating set of life conditions demanding adjustment, we would appear to have a valid hypothesis."

An important but seldom mentioned aspect of the Watts violence concerns the Los Angeles Negroes who had nothing to do with rioting. Uninvolved in the action, they were deeply involved in the emotions accumulating around the action. Dr. Wayne, medical director of Edgement Hospital, told us the story of the Negro members of the staff during those four days.

"We were in the hospital at the time of the first outbreak," Dr.

## Negro hospital workers feared they'd be connected with the lawlessness.

Wayne recalled. "There are a great many Negro psychiatrists, nurses, kitchen employees, and student waiters from City College on our staff. All of them were outraged by the acts of violence. Without exception, they were filled with a sense of guilt, shame, and fear because of their inevitable identification with the violent outbreak.

"These people were afraid of the violence on the streets and of the National Guard. They were distressed by the curfew. And they were afraid to go home. The hospital became their sanctuary. But they also wanted to stay there for another reason. Nearby Oak Hospital had been broken into and looting was going on just twelve blocks from our hospital. They thought that if we were invaded, they might carry some weight with the invaders. They wanted to protect the hospital.

"The deepest fear of these Negroes, who had no personal responsibility for the outbreak of violence, was that when they walked along the streets everyone in the city would connect them with the looters.

"This should not be taken to mean," added Dr. Wayne, "that these Negroes do not bear throughout their own lives a terrible amount of hostility and anger towards whites." However, all but a small group live under personal controls within a moral and ethical framework that makes violence impossible for them, and they remain constructive, functioning people.

#### Studies of violence

Dr. Pierre A. Bensoussan, associate psychiatrist of The American Hospital of Paris, in a study of delinquent behavior in what he calls dormitory suburbs outside Paris, links violence with such factors as:

- 1. Early family rejection.
- 2. Absence of deep emotional communication between members of the family.
- 3. Unconscious guilt feelings of parents.
  - 4. A weakened father image.
- 5. Impoverished collective and individual ethics.
- 6. Community abdication in many aspects of an educational role.

To this should be added a statement from a paper, "The Family as Breeding Ground of Violence," by Dr. Lidia Kopeknik of the Veterans Administration, Coatesville, Pa., that in 100 studies of penitentiary inmates, a high percentage of the families could be called rigid, unadaptive and unresourceful. These criminals came from families weak with internal vulnerability.

Beyond that, there are genetic elements, which many say are not well understood, social and political roots to violence. Criminals come from good environments as well as bad. Furthermore, the outlook of the whole society is important.

Dr. Wayne pointed out that the evil of violent action could not be condoned, even if it drew sustenance from existing wrongs. He added that there is no social sanction of violence in Los Angeles, as existed, for example, in Hitler's Germany where violence was honored. The exception in our society, he noted, was the street gang. The criminal leaders of the riots, he declared, draw support from the social wrongs and try to don a cloak of righteousness.

### No guilt feelings

But these people need no justification for their actions. The man of violence, the man who lives outside social rules, is not ashamed of his acts. He doesn't suffer guilt. He is generally incapable of being reached by psychiatric methods. It is usually only in prison that he is in touch with a psychiatrist at all.

"In fact," Dr. Wayne said, "Criminality is not a psychiatric problem at its base. It is a problem that goes far beyond the psychiatric approach. It depends more on the social, economic and political mores of the community than on psychiatric treatment of the criminal."

Dr. Wayne warned against a feeling of omnipotence on the part of psychiatrists, a belief that everything is a psychiatric problem. But psychiatry is trying to develop preventive methods. Dr. John E.

Snell, assistant professor in the Department of Psychiatry, Emory University School of Medicine, Atlanta, Ga., has recently reported that as psychiatry has become increasingly concerned with the problems of extending psychiatric services to a wider population, the need for innovations in diagnostic and therapeutic procedures has become evident. The Psychiatric Outpatient Clinic of Grady Memorial Hospital, Atlanta, accordingly, in July 1964 began to see all newly referred patients, for their initial evaluations, in open groups. These groups were bi-racial. Although the setting was clearly a completely novel one to almost all patients of both races in this clinic population, relationships based on empathy and understanding of others' problems developed rapidly in the groups of patients of different races. No serious problem of communication or anything else has arisen from the bi-racial makeup of these groups.

#### Joint treatment

Successful integration on the clinic level augurs well for the joint treatment of the Negro and white races. In the long run such an approach may contribute to the prevention of racial violence.

How can violence be prevented? Possibly by ending the rioters' feelings of isolation from the community, even from the middle-class Negroes.

Psychiatrist Daniel V. Voiss, M.D., senior medical officer of U.S. Naval Disciplinary Command, Portsmouth, N. H., says, "For the laws of the major social group to be effective in regulating behavior in a particular subculture, that subgroup must be able to constructively identify itself at least tangentially with the goals of the major group. It must be able to perceive in those goals some realization for itself. In addition, it must experience equal justice under the law."



"Well, that's progress for you."

## The play's the thing

Play production, as distinct from psychodrama, is a developing technique used for institutionalized patients. The experiences of Rita Lynn, volunteer play production therapist, and Dr. Richard Green, former resident in psychiatry, Neuropsychiatric Institute, University of California, Los Angeles, with amateur dramatics in the psychiatric hospital, as recently reported, throw light on this phase of hospital life.

### Four years of experience

Patients at this hospital for the past four years have staged a theatrical production with a cast of fulltime patients who were responsible for sets, costuming, makeup and technical details. The sole "outsider" in this venture was a professional actress who, as a volunteer worker, assumed responsibility for directing the production.

The initial resistances of both staff and patients were overcome as the mental health value of the project became evident. The values: the strong interest in a goal-directed project was generated; interpersonal transactions and team cooperative efforts resulted; the need for role shifts and adaptation to varying relationships proved beneficial. Conclusion: Play production can serve as a catalyst toward effective dealing with issues of health.

## THE ELECTRONICS STORY

## **Electronic pinch**

T HE four pictures at right show an actual case of a man wanted for auto theft as he wandered recently into the all-knowing arms of a new law-enforcement computer system.

New York City police have been testing the system since May to apprehend automobile and license plate thieves, scofflaws and drivers whose licenses or registrations have been suspended or revoked.

Known as Operation Corral (Computer Oriented Retrieval of Auto Larcenists), the system uses a UNIVAC 490 real-time computer. The license plate numbers of some 30,000 stolen cars and 80,000 scof-flaws are stored in the computer's memory drums.

An "observer" in one patrol car radios the numbers of passing cars at random to a teletype operator, who feeds the numbers into the computer. If there's a "hit," a police car up ahead is alerted within 5 to 7 seconds.

In three months, the system led to 100 arrests. The figure could have been 20 times greater if the officers present had had warrants in their possession for the arrest of scofflaws (those who ignore traffic summonses). That's now being worked on. Police expect that all those unpaid traffic fines will now be paid by wary motorists and help defray the system's cost (\$500,000).



Observer patrol car radios license numbers of passing autos to headquarters.



Policewoman teletypes numbers to computer, radios back if there's a "hit."



Apprehending patrol car some distance ahead intercepts the auto that's wanted.

Car and driver are apprehended. Police said man was wanted for grand larceny.



# INVENTIONS PATENTS PROCESSES

## **Instant walls**

Seven-eighths of the time required to erect conventional mortared walls can be saved with a new building method. The walls produced are stronger, cheaper, better-insulated and more blast-resistant than ordinary walls.

The Sulphur Institute and the Southwest Research Institute of San Antonio, Tex., have announced promising research with a construction method that bonds hollow concrete blocks with a hot-sulphurfibre coating. One thin coat cools within minutes and converts to a hard, impervious surface.

The new technique requires the

blocks of concrete or other material be stacked dry. Blocks are piled on one another until the size and shape of the wall are satisfactory. No mortar is put between the blocks, thereby eliminating one of the most time-consuming aspects of hand labor.

A thin coating of molten sulphur, glass fibres and a physical property modifier is painted or sprayed on the wall. Within minutes, the molten coating cools below its solidification temperature. In a two-year trial study building, the surface has remained weatherproof and well-insulated.

When walls are held together with mortar, the primary strength is compression. Very little tensile strength is present. Therefore, if the foundation shifts slightly, cracked walls and/or cracked mortar appear. The mortar that holds the

A workman can brush on molten sulphur bonding without special protective clothing.



blocks in place is the weakest part of the wall. In addition, the alkaline content of conventional mortar is so high it chemically degrades many fibres. A fibrous material, such as spun glass, can be added to the sulphur coating and resists longitudinal stress, such as that caused by a shifting foundation.

In initial tests, a 10-by-8-foot wall, containing a window of ordinary size, was built and coated with the sulphur finish. As soon as the coating hardened, the wall was lifted off the ground by a sling placed through the window. No matter how long a conventional mortar had dried, the joints would crack under such treatment. Yet, nothing happened to the wall.

The sulphur-bonded wall was put back on the ground and knocked down. It hit a patch of uneven ground and portions rested in the air after the landing. With conventional walls, faults would occur in the mortar in such a fall. In the sulphur-bonded wall, faults ran through the concrete, indicating that the coating's strength was equal to or greater than the concrete block's strength.

Preliminary t i m e-and-motion studies indicate that a sulphurbonded block wall could be erected in one-eighth of the time now spent building a wall.

The sulphur finish is yellow but various dyes may be added to the bonding material. Otherwise, ordinary house paints can be spread over the bonding. The finished building would look almost identical to today's concrete buildings.

If the initial studies are confirmed, the sulphur-bonding technique could fill the acute need for low-cost, rapid building, especially in areas where housing is inadequate for the population.

## Portable solar still

"Water, water everywhere and not a drop to drink" won't be the cry of salt-water-bound seafarers any more. An emergency solar still able to produce approximately two pints of drinking water a day has been developed as a side product of space research.

NASA's Manned Spacecraft Center in Houston, Tex., says the still weighs only one pound and occupies only 40 cubic inches when packaged.

It is made of polyvinyl chloride—the same plastic as auto seat covers—and black taffeta, which serves as a solar energy absorber.

The still inflates into a floating pyramid. An outer envelope of transparent plastic makes a window to catch radiation from the sun. Fresh water evaporates from a small pool of absorbed sea water and condenses on the plastic window. Then the distilled water runs down the sloping inside surface to an inside base and through a tube to a small weighted storage bag.

The stranded user doesn't have to drink warm water either. The weighted storage bag stays submerged and cools the water.

## Shock-free carpets

Wool and nylon carpeting may be soft to the tread, but few persons have not been jolted with carpet shock as they stepped onto carpeted hallways.

A new office appliance, a Moleculizer, applies a shield of millions of molecules to carpet fibers and shocks are no longer transferred to those who walk upon them.

The treatment can be applied

once or twice a year.

A trigger-type pump released the contents of a pre-measured vial of the chemical which generates the electrochemical molecules. Developer of the Moleculizer is the Shock Proof Corp. of Fort Lauderdale. Fla.

## Rock salt antidote

As the season for snow removal trucks begins, most motorists sigh, knowing that rock salt not only clears the roads but begins the rust that ruin's a car's lower portions.

Corrosion engineers estimate that rust damage from de-icing salts average \$100 a car in many cities in

the snow belt.

This year, a product called "Carguard" may be applied to the rock salt used by most cities for de-icing streets. It turns the salt lemon vellow and costs about 16 cents a year per car, estimates Dr. Richard Baldwin, vice president and executive research director of Cargill, Inc., of Minneapolis, Minn., the manufacturer.

"Carguard" is composed of two rust-inhibiting agents. One provides a protective film to the negativelycharged areas of metal surface, the larger areas. The other agent causes a coating of metal oxides to form over the smaller, positive-charged spots. These are the areas subjected to metal-eating rust. Carguard will not inhibit initial pitting, but once it begins, the product reacts with the auto metal, causing insoluble metal oxides to build up in the pit to, and above, the surface level. Without this effect, the pits would continue to deepen.

A road test in Davenport, Iowa, last winter, showed Carguard provided 87 percent protection against rock-salt-induced rust on flat steel surfaces and 80 percent protection



A Cargill chemist measures corrosion pits in salt-exposed metal during rust research.

on creviced surfaces or joints.

A patent is pending on the product which will be marketed this year. Dr. Baldwin said the inhibitor has no harmful effects on automobile paints, shoes or clothes.

## Bar snoop

Radio waves may soon be dancing through liquor bottles in a plot to make drinks on the house a forgotten folkway.

The electronic device, awarded Patent 3170597, attaches to open bottles in a bar. Miniature transmitters emit radio signals which show the number and price of drinks as well as the amount of liquor dispensed. A central receiver records this information so that at the end of a shift, cash receipts can be checked against the record.

At present, bars are one of the few remaining retail outlets where bulk sales are not subject to exact accounting procedures. If the man behind the bar feels generous, a fractional underpour of other drinks can make up the difference.

A survey by the Bank of America shows that the average bar's cost of merchandise is 56 percent of retail sales, although it should be 26 percent, based on normal wholesale prices.

With the electronic device, bottles can sit upright and drinks can still be poured in front of the customer. But the radio transmitters will be tallying the drinks, nonetheless.

## Cooking in seconds

A new microwave oven (see Science Digest, Aug., 1964) can heat a complete hot meal less than two minutes after a customer's order. The low-cost, compact microwave oven for commercial and instutitional use is marketed by Atherton division of Litton Industries, Cleveland, Ohio.

The oven is one-half the weight and two-thirds the size of earlier commercial microwave ovens. Two of these models can be stacked in space normally required for a microwave oven.

Key difference in the new design is a smaller and more powerful aircooled magnetron tube. Electrical and mechanical systems are simplified and miniaturized. About half the components required in earlier models have been eliminated. The oven also operates on a standard 110-volt circuit rather than the 220-volt circuit needed previously. The oven will warm up instantly and shut off automatically.

Dimensions are 21 and fiveeighths inches wide, 14 and seveneights inches high and 21 and onehalf inches deep. The oven weighs half as much as earlier models. It will be priced between \$695 and \$850 depending on quantity.

Preparation time for refrigerated foods are: sandwiches, 10-20 seconds; vegetables, 15 seconds; servings of roast beef, 20 seconds; complete dinners, 60 to 80 seconds.

## INVENTOR OF THE MONTH

## He earned his own success

ARL HOEHN (pronounced Haine) of Red Deer, Alberta, Canada, is proof that to be successful a modern inventor need not always have a technical degree and work in the research laboratory of a big corporation.

A self-taught motor mechanic, the Science Digest Inventor of the Month (right) designed a recently patented fuel control valve for cars. He also sees rosy prospects for a number of his other inventions.

By the time he picked up Patent 3,199,458 in Washington recently, 50,000 of the gasoline pressure regulators had been placed with Canadian distributors and 18,000 of them had been sold to customers at \$8.95 apiece.

Karl Hoehn is counting on a mass market in the United States, and is confident that a pending contract with an American manufacturer will be closed.

The inventor, a husky man of 33, has gained intimate acquaintance with cars and trucks through running a chain of filling stations in two Canadian provinces.

His Fuel-O-Matic control valve is said to prevent engine stalling from carburetor flooding, rough idling and "vapor lock," as well as to increase mileage. The regulator holds pressure at the carburetor to four pounds per square inch, and feeds excess



Karl Hoehn holds his fuel control valve.

gasoline back through the fuel pump.

The regulator comes in a kit and can be installed "in minutes." A modified form, consisting of an adapter disk inside the fuel pump, is intended for new cars.

Another Hoehn invention, for which he filed a patent application while in Washington recently, turns on the parking light if a head lamp fails, so that an oncoming driver is not misled into thinking an approaching car is a motorcycle.

Last July, Karl Hoehn was an exhibitor at an inventors' conference in Swift Current, Saskatchewan. He was selected to display nine of his inventions on two 15-minute Canadian television programs in the fall.

-Stacy V. Jones

## BOOK IN THE NEWS

## The organization monkey

Social spheres and activities of non-human primates—monkeys, chimpanzees and apes—are defined and analyzed in a new book of field studies. Serious in approach and academic in tone, *Primate Behavior* (Holt, Rinehart and Winston, Inc., \$10) brings together 18 recent studies in this newly-developed field.

The focal point of primate field studies is the social organization. All aspects of group living are recorded—the size of a monkey group, displays of dominance, communication, maternal care of infants and interactions of the group members.

Infants depend on their mothers for over a year. An extended child-hood of four to seven years gives them time to be educated. For example, a young female learns to handle infants and watches their care long before she is physically mature enough to be a mother. A female comes of age between her fourth and fifth year and a male takes about two years longer to reach physical and social maturation.

During their adolescence, monkeys frolic with their age peers and learn how and when they may approach adults. Female primates spend their entire lives within the confines of an organized group. Most males spend the *majority* of their lives within a group. During



The leader of a rhesus monkey group on Cayo Santiago relaxes as a high-ranking sub-adult male attends to his hairdressing.

late adolescence, however, the males frequently live on the fringe of a group. Once in a while, a male will move from one group to another, usually acquiring a higher status in the new group than he held earlier.

It's often each man for himself in the primate world, however, when individuals are in danger.

Phyllis Jay, after 16 months of observation, reports:

"Social relations in a north Indian langur group are not oriented primarily to protection of the individual by group action. Unlike macaques or baboons, a langur protects himself as an individual most effectively by dashing up into the nearest tree, instead of depending for protection on large adult males with well-developed fighting prowess.

"This relaxed nature of langur

life is one of the first characteristics an observer notices," she comments.

The langur group and rhesus group contrast sharply. The latter are more boisterous, much noisier. Frequently the two groups "live together in the same area and use many of the same food and sleeping trees as well as the same sources of water." Although the two groups share the same environment, rhesus are "more intense, quicker moving, more easily provoked to threat, more aggressive and more vocal than are the relaxed langurs."

Monkeys indicate many social relationships by neatness. They will spend hours daily grooming one another, removing leaves, dirt, lice and smoothing their coats. Often it appears that a subordinate monkey will groom more important monkey to cultivate its friendship. Sometimes grooming occurs between a male and a female.

The trained observers tried to identify and report as many activities as they could see. For example, Jane Goodall, an English observer in the Gombe Stream Chimpanzee Reserve in Tanganyika, describes tool use in a chimpanzee attack on termite hills. The chimps first scrape away an insect-placed sealer and pick a grass stalk to poke down the hole.

"The grass or other material selected is not normally longer than about 12 inches," she writes. "When one end becomes bent the chimpanzee either turns it around and uses the other end or breaks off the bent part. When the tool becomes

too short to be of use, a new tool is selected, and if this is too long, the chimpanzee usually breaks a piece off; if a leafy twig or vine is selected, the leaves are stripped off with the lips or fingers.

"... On several occasions, when the nearest termite hill was at least 100 feet away and out of sight, a chimpanzee picked a grass stalk, carried it to the termite hill, and used it as a tool. One male carried a grass stalk (in his mouth) for half a mile, while he examined, one after the other, six termite hills, none of which was ready for working." The termites are a tasty seasonal addition to the usual diet of greenery.

*Primate Behavior* is abundantly illustrated with photographs taken by the observers.

One major problem confronting the observers is the difficulty in watching undisturbed animals for many consecutive hours throughout the day. Baboons at Amboseli, Kenya, for instance, behaved differently when human observers in a jeep were in their midst as compared with observations through binoculars. Plains animals are much easier to see than monkeys, gibbons and orangutans that remain about 100 feet or so from the ground, and are frequently obscured by foliage.

Systematic studies in the field have been conducted only for the past dozen years. Observers are quick to state that these are initial studies and, for the most part, include no experimental procedures or quantification of material.

J. R.

# THE PROGRESS OF MEDICINE

## People who swallow things

by Arthur J. Snider

Y ou've admired shoemakers and carpenters who pitch a handful of nails into their mouths and project them one by one between the lips.

They're experts, but even they accidentally swallow nails on occasion, says a St. Charles, Ill., surgeon. Dr. George A. Wiltrakis has taken objects out of stomachs of scores of patients, including the very young, the very old, the mentally ill and certain other occupational groups besides shoemakers and carpenters.

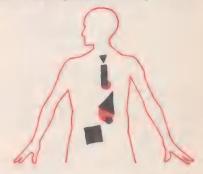
Most objects—perhaps 90 percent—pass through without incident. Others may be retained without symptoms even for a long time. But still others may perforate the gastrointestinal tract, cause hemorrhage or intestinal obstruction, or form an abnormal canal in the body.

"If there is a large accumulation of foreign bodies forming a compact mass of metal, there is only one procedure and that is surgical removal," Wiltrakis told a recent meeting of abdominal surgeons.

He projected a slide showing a mass of iron the size of a grapefruit and another slide showing a mass of bedspring that had been swallowed.

He told of a 42-year-old woman

who swallowed a 12-inch corset stave, and a 35-year-old mental patient who swallowed a toothbrush. The name on it showed the brush belonged to another patient.



"Large objects can and do pass at times through the intestines," Wiltrakis pointed out. "I remember a psychoneurotic female of 24 who had repeatedly swallowed foreign bodies. I thought I might shame her and thus have her stop her foreign body diet. I told her to stop eating all the small things—to eat something big like a door handle or a door.

"The next morning the nurse asked me if I had heard what happened. I looked. The door was still present and so was the doorknob. But the patient had swallowed a five-inch iron hinge bolt from the door. I was surprised on serial X-rays to observe it pass the curve of

the duodenum and continue down through the intestinal tract and almost break the bedpan when the patient successfully passed the fiveinch bolt. The mobility of the second portion of the duodenum is amazing."

Large, sharp objects present a special problem, Wiltrakis said.

He related the case of a patient who was admitted to the hospital with acute abdominal pain suggesting peritonitis. On an X-ray, it turned out he had swallowed a large (eight-inch) bedspring and a smaller hooked one.

The larger spring had perforated the small intestines, and the smaller was surrounded by a string. Its removal was possible by pulling on the string.

Wiltrakis offers this advice:

If a foreign object is sharp or of any significant size, the patient should be hospitalized and closely observed. Avoid laxatives and cathartics. Roentgenographic (X-ray) observations of the movement of the foreign body should be repeated daily or at least every second day.

Large objects should be removed early. Small and dull objects usually pass without difficulties. If surgery is to be done, X-ray the patient on the day of the operation, as the foreign body may have moved since the last film was taken.

Foreign bodies often are removed from the stomach by flexible forceps inserted through a tube. A negative suction method also has been devised.

### Mosquito-proof man

Medical science has found an unattractive man—to mosquitoes, that is. Hopefully, the secret of his repugnancy may lead to development of an ideal insect repellent for the less fortunate.

The unattractive man was found among 838 intrepid volunteers who, never having been bitten by mosquitoes, deemed themselves somehow to be physiologically armorplated.

Mosquitoes were placed in tiny cages and held to the skin surface of the test subject's forearm for three minutes. By crushing the insect between folds of a paper towel and noting the presence of blood, it was determined whether the mosquito had fed, a more reliable indicator than bite marks on the skin.

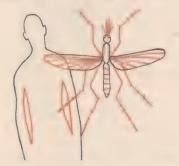
Of the 838 volunteers, 17 escaped a bite the first time. When the 17 were tested again, all but one was bitten. He was tested nine more times but the skeeters shunned him as if he were DDT.

So far, exhaustive studies of the individual's medical and dietary tests have failed to show why he has built-in mosquito protection, says Dr. Howard I. Maibach, San Francisco, University of California dermatologist.

Other individuals showed interesting characteristics:

One, a 21-year-old man, was unable to sweat. On warm days, he relieved the burning sensation in his skin by applying cold, wet towels. On hot days, he remained in a cool basement. He was found to be markedly less attractive to mosquitoes until water was applied to his skin.

Thirty-nine individuals above 50 were studied to determine if age bore enchantment. The older individuals were significantly less attractive. Dr. Maibach said this phenomenon is being studied to see if it relates to decreased sweat production with age or great release of carbon dioxide. Patients with psoriasis, a skin disease, also were found to appeal less to mosquitoes.



Zoologist A. W. A. Brown, of the University of Western Ontario, London, also observed moisture to be a powerful factor. But when the moisture reached 100 percent humidity, the mosquito is repelled.

Dr. Brown found warmth to be the next most attractive factor. Even dry billiard balls became targets if raised to temperatures under 110 degrees. Another attractant is female sex hormone placed on the victim's skin.

While no man-made repellent has yet achieved 100 percent effective-

ness, a compound called "deet" was identified by Irwin H. Gilbert of the U. S. Department of Agriculture, Gainesville, Fla., as the "best" thus far. Applied to bare skin or clothing in tests in Alaska, Panama and intermediate locations have proved deet's effectiveness, he said.

### How to live with angina

One can live long and well with incurable angina, the chest pain caused by a spasm in the coronary artery. A leading cardiologist, Dr. Arthur M. Master of New York, found in 31 cases:

- The outlook in the disease is much brighter than had been believed.
- Three-fifths are living for up to 33 years with their condition. Only four are unable to work.
- Among those leading full lives, a remarkable feature has been their ability to change their philosophy of life.

"Instead of continually striving for greater wealth or position at a hectic pace and at the cost of long hours of work and social activity, they have come to be content with lesser material attainments," Dr. Master comments.

"In conducting their business, family and social relationship, they look benignly at the foibles of people around them.

"They avoid quarrels and bickering at home, eat and smoke less, dress according to the weather and avoid strenuous exercise.

"Heated discussions are taboo,

whether with one's wife, children, employees, partner, taxi driver or competitor."

Discussing treatment, Dr. Master says the pill, nitroglycerin, is the old standby when pain occurs. He says patients should be encouraged to use the drug without hesitation, and as often as necessary until relief is obtained.

Nitroglycerin also should be taken prophylactically, before specific exertion, he adds. In the 10 percent of patients who do not obtain relief with nitroglycerin, whiskey or a narcotic can be helpful.

None of the drugs that dilate the blood vessels have been found to be helpful, Dr. Master says. Sedatives allay anxiety somewhat but are not directly helpful in angina itself.

Radioactive iodine is becoming increasingly popular as a treatment but its effect is unpredictable and there may be disturbing side reactions.

The several operations that have been devised over the years for angina have largely been discarded but there is a revival of interest in the so-called Vineberg operation in which a vessel which ordinarily carries blood to the mammary gland is re-directed to bring more blood to the heart muscle.

## An eye doctor's advice for putters

Is your putting game off? Try striking the ball in croquet style. A medical specialist says this position for putting is more "physiologic."

The conventional putting stance—feet placed at right angles to the hole and body crouched over the golf ball—violates medical principles of depth perception, says Dr. William W. Vallotton, ophthalmologist at the Medical College of South Carolina.

He recommends facing the hole with feet parallel to the path of the stroke and the mallet-shaped putter between them.



"All of our daily activities requiring good binocular vision are carried out with eyes forward," says Vallotton. "Yet we try a most difficult task, such as putting, in a most unphysiologic way. You cannot get good stereoptic vision."

Here's why: The golfer is crouched over a ball 1.68 inches in diameter to be hit into a hole 4½ inches in diameter. He looks out of the side of his eyes with his head tilted. If he has a particularly large nose or nasal bridge, the vision from one eye may be cut off entirely.

Thus, if he is right-eyed, as are most people, he is looking at the hole out of a non-dominant eye. The monocular vision does not provide depth perception.

As a test, Vallotton took 53 golfers into the laboratory for a depth perception examination, using both the conventional putting position and the forward stance.

"The average deviation with the head tilted was 52 millimeters, he reported. "Without the head tilt, it was 18. The better golfers averaged no better than the duffers, probably since this was an unfamiliar test to both.

"The findings tended to make me think of the causes of 'hot and cold' streaks. The reason is probably not that his old putter has gone sour on him but that his eyes have temporarily developed a little more phoria (turning in or out), which manifests itself in the usual head position of putting."

Impressed with the oculo-physical coordination improvement, Vallotton changed to the front stance and promptly knocked seven strokes off his game. Now an infrequent "Sunday golfer," he shoots in the 90's, but as a regular he usually broke 80.

"You'll find yourself getting down in one putt more often," he comments.

The Professional Golfers Association does not forbid the new type of putting and several professionals have tried it from time to time.

However, when the chips are down in big competition, most pros resort to their standard method of putting.

For the technical-minded, here is

## Russians Learn While Asleep

#### (WE KNEW IT ALL THE TIME)

News items appearing in newspapers and magazines throughout the nation report that: "In the Kiev State University, a woman student mastered a complete course in English in 28 nights."

"A philologist at the Ukrainian Academy of Science says that sleep-learning is less tiring to the brain than normal learning."

This "new" Russian discovery has been in use for over 2,000 years. In the United States sleep learning has been actively used since 1922 when Chief Radioman J. N. Phinney of the U.S. Navy successfully taught Continental Code during sleep. Since then, the use of sleep as a time for learning every kind of material, has become a reliable and accepted addition to our learning programs. The technique of sleep learning is being used by professionals, students and instructors, sales and corporate executives, housewives and mothers . . . along with many personalities in the public eye such as: Jan Sterling, José Ferrer, Red Buttons, Efrem Zimbalist, Jr., Sam Wanamaker . . . and many others — who use the time of sleep to absorb information effortlessly and painlessly for instant recall when awake.

To acquaint the readers of this newspaper with the simple techniques that allow constructive use of your sleeping hours, the Self-Development Research Foundation, a leading researcher in the field of learning while asleep, has published a compilation of Research Studies. These easy to understand reports tell you how to absorb any material while you sleep. Learn languages; learn to relax and control tensions; control your weight; sharpen your memory; develop your sales ability — all while you sleep, and without losing your rest.

This 26 page report is yours free. No obligation and no one will call. Simply enclose a dime to cover cost of postage and handling. Send your name and address to: Self-Development Research Foundation, Dept. X-26, 207 East 37th Street, New York, New York 10016. Please include your ZIP CODE.

Vallotton's professional explanation, as reported recently to the Southern Medical Association:

"After the head is tilted more than 13 degrees from the vertical meridian, the cyclotorsional movements of the eye are unable to functionally rotate the eye.

"The vertical muscles begin acting as horizontal muscles and the horizontal muscles as semiverti-

cal muscles.

"The inferior oblique muscles whose over-action occurs in many normal people, is in an optimum position to wreak havoc with the finer fusional components of binocular vision.

"A mild esophoria or exophoria now becomes a semivertical abnormality, especially when one eye is blocked out by a large nose—a transient tropia."

#### How long you'll live

If you are a man somewhere between 35 and 36 years of age, you have reached the point where you may expect to live just as long again. If you are a woman, you won't reach midpoint until somewhere between 38 and 39 years, on the average.

Both men and women do even better if they live in South Dakota, Nebraska, Kansas and North Dakota.

Clergymen, teachers and lawyers have a later mortality rate than the general population but physicians have little advantage.

College men have a five-year

bulge over non-college men and honor students, two years over college men. Athletes are little different from that of the college men in general.

These findings are set forth in the new book, Factbook on Man From Birth to Death, by Louis I. Dublin (Macmillan). He's a retired statistician of the Metropolitan Life Insurance Co. and one of the world's experts in assembling and analyzing human statistics.

Among the book's 1,001 questions and answers:

Q. Are there many authentic cases of persons to have lived to be 100?

A. Cases of extreme old age are usually reported where illiteracy is frequent and where record-keeping is notoriously poor — in other words, where the facts cannot be verified. . . . An English actuary who searched British insurance and annuity files found only 30 acceptable cases of centenarians among 800,000 lives.

Q. Has there been any change in the longevity of Presidents of the United States?

A. The Presidents who were inaugurated before 1850 outlived the expectation of life they had at the time of taking office by an average of 2.9 years. Those inaugurated between 1850 and 1900 failed to reach their expectation of life by about 2.9 years on the average. Those who have served during the present century have averaged 11 years less than was to be expected when they took office.

### TIPS AND TRENDS

NEW COMPUTER USES: In San Francisco, space engineers have been analyzing crime causes and incidence by computer and finding possible antidotes. In Chicago, St. Louis, San Francisco as well as New York (see p. 23), computer analysis of police operations is measurably increasing their efficiency. And in Washington, Internal Revenue lawyers are knocking 90 per cent off the time they need to research precedents by using computers.

NEW PHONE FOR THE DEAF. AT&T in New York is offering Sensicall. For the deaf who can see, it translates long and short sounds into long and short blinks of light. For a deaf-blind person, there's a vibrating button. (See Science Digest, May, 1965.)

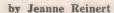
PROPHETS OF DOOM. A UCLA professor of meteorology says smog from the internal combustion engine will wipe out man in 100 years. If he lasts that long. "The Hungry Planet," by Georg Borgstrom, says the world will be unable to feed its estimated population of 15 billion in the year 2025. If we last that long. An asteroid named Icarus could collide with the earth on June 15, 1968. At best, says a Smithsonian Astrophysical Observatory scientist, the encounter with the rock will be a near miss.

BEWARE AUTO COMFORT. The National Safety Council is taking a new look at auto accident causes. One possibility: The comfort of new cars may lull drivers' reflexes.

### THE PHYSIOLOGY STORY

Now—a drug that "cures" drug addicts

Dr. Vincent Dole of Rockefeller University helped develop the methadone treatment.



HEROIN, an expensive habit, requires more and more—finally controls all—of a narcotic addict's time and attention. It is a habit so severe that its victims dream of it, talk constantly of it and of ways to support the addiction.

"Mainliners" are so called because they shoot heroin directly into their veins. As their bodies become accustomed to the drug, they develop a craving, a physiological dependence on it. Their bodies cannot function properly without regular-two to eight shots a daydoses of heroin. Soon, getting their hands on heroin becomes a compulsion: addicts will hock the family television, steal the week's grocery money, pick pockets, shoplift and snatch purses to continue buying heroin. A bag, enough for one shot, sells for \$5 to \$10.



Rockefeller University

There are about 50,000 addicts in New York City alone. It is estimated that they must raise from \$500,000 to \$700,000 per day to support their habit. Estimates of addicts throughout the country range from 75,000 to 1,000,000. Accurate counting is impossible because the use of narcotics, except for medical purposes, is illegal. Hence, addicts must support their habit through supplies obtained from the underworld. It's a crime to buy, sell, use or possess heroin by federal law. It has no legitimate medical use in the United States.

The rate of cured dope addiction is very, very low. The Federal Narcotics Hospital in Lexington, Ky., reports that more than 90 percent of patients who "kick the habit" (withdraw completely from drugs) and undergo counseling and rehabilitation, are hooked again within six months. These results are above

average for treatment programs throughout the country.

What hope can be extended to heroin addicts?

Today, in New York City, 22 former addicts are, for social purposes, cured. All of them had been on drugs for at least four years. The average addiction period was more than nine years each. These men are as excited as their doctors about a substitute drug that offers the first medical hope every extended mainliners.

The synthetic drug, methadone hydrochloride, is chemically similar to heroin. A dose of methadone equal to heroin satisfies the heroin addict's physiological dependence. And the changeover from heroin to methadone has no ill effects.

Methadone releases an addict from his incessant desire for more heroin. Instead of thinking and talking all the time about drugs, the addict can turn his attention to school, jobs, self-support and becoming an individual again.

Drs. Vincent P. Dole and Marie Nyswander put the first two patients on methadone in February, 1964, under the auspices of a research program at Rockefeller University in New York. They used higher doses than had been used previously because the patients were accustomed to drugs.

"We knew," said Dr. Nyswander, "That methadone was a very effective painkiller, and that it had long-acting properties and minimal withdrawal symptoms. What we then discovered might not have

been apparent if those dosages had been a lot less, as they had been in some other, not so successful, experiments with methadone."

#### Big changes

Dr. Dole first realized that big changes were taking place in the patients when one began to paint industriously and the other begged the staff to let him work on a high-school equivalency diploma. Today, the first patient, an addict for 13 years, has completed his high school work and is enrolled in horticulture school. The other patient, an addict for six years, completed three years of high school in a year and a half with A's and this fall enrolled in college, a scholarship holder.

"The most dramatic effect of this treatment has been the disappearance of narcotic hunger," the two physicians recently wrote in The Journal of the American Medical Association, "All of the patients previously had made efforts to remain drug-free after withdrawal, but were unable to resist the craving. Drug hunger became intolerable for most of them shortly after discharge from a withdrawal unit and return to their neighborhood. It became especially severe when they were exposed to emotional stress. With methadone maintenance. however, patients found that they could meet addict friends and even watch them inject diacetylmorphine (heroin), without great difficulty."

How does treatment begin?

#### Withdrawal symptoms from drugs may kill the drug addict.

Patients come from the street, from drug withdrawal units, from referrals by physicians and social agencies who have heard of the program. Some are recruited by patients under treatment. All have been addicts for at least four years.

At the Manhattan General Division of Beth Israel Hospital, where the pilot study was conducted, most newly-arrived patients showed mild to severe symptoms of withdrawal as several hours had passed since their last shot. Symptoms include nausea, severe headaches, convulsions, muscular aches and pains, yawning, sweating and a desperate desire to get a "fix" of heroin.

Symptoms usually begin about eight to twelve hours after the last dose and increase in intensity. They reach a peak between 36 and 72 hours after the last shot, then gradually dwindle over the next five to ten days. Weakness, sleeplessness, nervousness, muscle aches and pains may persist for several weeks. Sudden withdrawal can cause death.

Patients with symptoms are given a drug to relieve them, then methadone treatment begins. Treatment can begin immediately if withdrawal symptoms are not present. After one day, the amount of methadone necessary can be determined and the patient "simply feels normal" while taking the new drug,

according to Dr. Nyswander.

Each patient is hospitalized for a week, during which he is given a medical checkup, psychiatric evaluation, a review of family and housing problems and a job-placement study. For another five weeks. patients are allowed to leave the ward during the day. They can go to school, libraries or shopping. Frequently, a staff member goes with them. Patients who were highschool dropouts start attending classes. Since most patients are anxious and dubious about the treatment, wards have been limited to four to nine patients. This allows time for each one to receive individual attention

#### Daily medication

After the six-week period, patients are returned to their homes, visiting the hospital once a day for a dose of methadone. They must drink the medication with a clinic nurse watching. Therapy at this stage includes help in obtaining jobs, housing and an education, if need be.

If a person has taken drugs, the effect registers in an analysis of his urine for three days. Treatment with methadone also registers. Thus, patients are required to leave a daily specimen for analysis. This insures detection of drugs if they are taken unknown to the hospital staff.

One of the surprising effects of methadone is that it blocks out other narcotic effects. If a patient taking methadone shoots heroin—and four did that—it has no effect. They don't "get high." Further, the four reported their lapses, virtually an unknown action for an addict under treatment. Thereafter, they advised other methadone patients not to bother with heroin.

Addicts who are hooked on heroin, a narcotic, lose their sensitivity to physical and psychological stimuli after a shot. They feel cut off from reality and are frequently exhilarated. Thus, when they try to break the habit and confront problems, they are drawn to heroin, knowing it is an easy "out."

Tolerance, however, builds up in the person using heroin. Ever-increasing doses become necessary to produce the same euphoric effect. This is not true with methadone. Dosage remains stable and, to date, no side effects have been found.

Patients treated with methadone have undergone repeated tests of all types—bone marrow, X-rays, motor coordination, blood analyses and muscular function. Drs. Dole and Nyswander report that they have not been able to find a medical or psychological test capable of telling the difference between a normal, non-addicted person and someone being treated with methadone. Only a urinanalysis will distinguish a former addict.

It is as easy to give a heroin addict methadone as it is to give a diabetic patient insulin. In both instances, patients can live normal lives while on medication. Perhaps later, methadone patients can be taken off all drugs, but experimentation has not advanced to that stage yet.

The program is growing. The methadone project was expanded in the fall to four New York City general hospitals. Four women have been accepted in a program for female addicts.

#### Differences erased

Hope runs high for the newly-discovered methadone treatment. Several of the addicts have been employed by the Manhattan General Hospital. Others are serving as clinic attendants for the new programs. "So far," says Dr. Nyswander, "not one visitor to the Rockefeller Institute hospital or Manhattan General—not even a narcotics agent—has been able to tell for sure the difference between the patients and the staff."



"Gee, listen to this! 83.6% of the population of the United States above the age of 15 are fascinated by statistics."

## THE ASTRONOMY STORY

#### When we had two moons



Poor Lázaro Melovich. There isn't a rock to be found in the flat, dry north of Argentina. But he had a big one. Every year at cotton-planting time he caught his plow on it. Then those Americans and professors from Buenos Aires came out to Chaco Province and started digging around. So he dug out his rock (see above). It turned out to be three tons of iron. Now the professors are telling him the earth once had two moons and one fell on his farm. Such luck.

But William Cassidy from Columbia University's Lamont Geological Observatory and Luisa María Villar from the U. of Buenos Aires were delighted. El Taco meteorite, as they named it, was their biggest find.

They were leading the ninth expedition to visit the area in 400 years. And this time they were doing it right. With aerial surveys and mine detectors they added four more craters to the five already known and turned up thirteen and a half tons of iron meteorites.

The largest crater was about 100 yards across. The party cleared the thorn trees from a smaller, better preserved crater and dug a trench through it. About four feet down they found a burnt stump and other charcoal remnants of the forest fire started by the flaming meteor. Carbon-14 analysis dated it 4000 B.C.

But their most spectacular find was their conclusion. Earlier conclusions about the sites had been fanciful, but not more fanciful than theirs. The first Spanish explorers had heard from the Indians about a block of iron that had fallen from the sky into the Field of the Heavens. Expeditions in 1774 and 1776 checked on it, hoping to find silver deposits, like those in Peru. The samples they brought back proved to be extremely pure iron.

Back went more expeditions to look into starting an iron mine. Lieutenant Miguel Rubín de Celis of the Royal Spanish Navy did such a thorough job prying and digging that he apparently buried the 15-ton block. It hasn't been found since.

Finally, in 1803, a one-ton piece of iron was recognized as a meteorite and sent off to the British Museum. Still, as late as the 1920's an investigator sized the place up as the work of the Indians. They had dug several depressions and hidden a meteorite in one, he said. Ten years later someone else realized that the depressions were meteorite impact craters.

Cassidy's group found that all the craters fell on almost a perfect line running more than 10 miles from the northeast to the southwest. A thousand miles to the northwest, they noted, a parallel line of craters ran along the coast of Chile.

Both lines may result from the same meteor, they believe. The earth probably captured a passing meteor and for a while made it a second moon. The orbit was almost circular, with the point of closest approach at the latitude of Argentina. It was too low to last. First, the gravitational pull of the earth produced tides in the meteor that tore it apart. Then the thin upper atmosphere braked it to a spiralling descent.

One swarm of debris plunged into the Chaco plain out of the northeast sky. Another swarm continued around for one more orbit during which the earth spun to the east, moving Chile under the next bombardment 88 minutes later.

Lázaro, you're lucky you weren't there then.

### Are You A Slow Reader?

A noted publisher in Chicago reports there is a simple technique of rapid reading which should enable you to double your reading speed by this simple, proven method and yet retain much more. Most people do not realize how much they could increase their pleasure, success and income through reading faster, easier, more accurately. The details of this method are described in a new book "Adventures in Reading Improvement" sent free on request.

According to this publisher, anyone, regardless of his present reading habits and reading speed, can use this simple technique to improve his reading ability and develop it to a remarkable degree. Whether reading stories, textbooks, technical matter, it becomes possible to read sentences at a glance and entire pages in seconds by fol-

lowing this method.

To acquaint the readers of this publication with the easy-to-follow rules for developing rapid reading skill, the company has printed full details of their interesting self-training method in a new book, "Adventures in Reading Improvement," which will be mailed free to anyone who requests it. No obligation.

Simply send your request to: Reading Improvement Program, 835 Diversey Parkway, Dept. C788, Chicago, Illinois 60614. A postcard will do.

### 12 ways to handle the stress of modern living

by Duane Valentry

DO YOU brux when watching television?

Bruxing is what they call gritting the teeth, a habit scientists today relate to physical and mental stress.

Three German doctors report that television contributes considerably to stress. Tension and excitement generated by TV, they found, increased production of stomach acid by 50 percent in 24 persons studied before, during and after they watched stimulating shows. The same degree of stress was experienced when the viewers watched annoying commercials or hated the show intensely.

Television is only one source of modern stress. "It is doubtful if man has ever considered himself under more stress than he does today," says Dr. Harold G. Wolff in a report for *Modern Home Medical* Advisor.

How harmful is stress?

"No one can live without experiencing some degree of stress all the time," says Dr. Hans Selye, leading authority on the subject.

"Each of us has his own 'stresslevel.' It isn't the amount of stress alone that determines whether it is harmful or beneficial, but the amount you can take. When stress is an invigorating force that helps you adapt to the challenges and changes of your life, it becomes a means of bringing about harmony rather than harm. But when it overwhelms you, wearing down your sense of



well-being, then stress becomes an enemy."

A few rules, say the experts, will help prevent harmful stress:

#### 1. Get out of that groove

Monotony makes for stress. Break the pattern, break away from monotony.

"Give in to your natural craving for variety," says Dr. Selye, "often it's nature's way of safeguarding you from stress caused by sameness."

The man or woman without enthusiasm for their job or even with "quiet despair," may find the cure to be a simple change of routine or a matter of better motivation, or a new job altogether.

Sometimes a change of outlook—

perhaps a vacation, a new hobby, for a woman a new hairdo or supermarket is all that is needed. According to Dr. Selye, we have, above all, the need for self-expression.

#### 2. Blow off steam

In Tokyo, workers in a certain plant can go to a room equipped with punching bags and targets with the faces of various bosses painted on them. Here workers are welcome to punch away or take a pot shot to get rid of a "mad."

"Work off your anger," advises Dr. George S. Stevenson, consultant for the National Association for Mental Health. "If you feel like lashing out at someone who has



provoked you, try holding off that impulse for a while. Meanwhile, use your pent-up energy in some physical activity."

One way to blow off stress-causing steam harmlessly is through exercise. Of two groups of students studied at the University of California, one exercised regularly, the other did not. Periodically each group was subjected to nervewracking conditions. The group that exercised regularly recovered or adjusted from imposed tensions more quickly than the other.

"It showed that regular physical exercise not only increases nervous stamina appreciably but serves another equally valuable purpose," summed up the report, "it provides an effective means for release of emotional tensions. Unless these tensions are discharged, pressures continue to multiply."

#### 3. Reduce problems to size

"Executives with expense ac-

counts used to worry about business; salesmen used to worry about their quotas. Now they worry about tension, ulcers, too soft living and stress," said an editor recently.

The worry habit occupies much of the average person's time, and frequently the worry is about little problems. Fuming and fretting over minor irritations such as traffic, parking or inconsideration of others build up much of a day's stress.

"Ask yourself how these problems really affect you," says Dr. Frank Hamilton. "Are they important in your life? Do they actually affect you, or do they just make you fearful of what might happen? This sort of objectivity helps you take the next step in reducing problems to size. After you have noted the things that have an actual bearing on your life, stop and coldly consider what you can do about them. Can you do something concrete to eradicate the effect or nullify the probable effect? If so, do it!"

#### 4. Prepare for the unexpected

People suffer stress when the unexpected jostles them out of an accustomed pattern. Bad news, a crisis in business, an injury, or only an unexpected caller may upset a person.

Threats to safety, well-being, happiness and self-esteem produce tension—so do unexpected guests for some people. Learning to cope with minor unexpected situations develops "muscles" for the big crises when and if they come along.

#### 5. Talk about it

Talking releases stress and strain, especially for the one too close to a situation to see it in the proper perspective, or in emotionally charged situations that may be hard to handle intelligently.

"If your problem could be settled by an expert in some field, go to him quickly and take his advice," says psychologist Dr. Austen Riggs. This may be a clergyman, marriage or youth counselor, doctor, friend or relative.

#### 6. Do it now

Putting things off accumulates stress. It helps to make a list of tasks you must do—this puts them in order—then finish them as soon as possible. Appoint a definite time to do things. Action eliminates this stress accumulation.

#### 7. Get experience where needed

A man may be completely flustered because he has to talk before a group. As his fear grows, so does his stress. Someone else gets rattled because several things happen at once—the important appointment is interrupted by another important contact that calls for careful handling. A student goes to pieces during an exam.

Stress can best be overcome by being better prepared to attack a situation, and by being confident of your abilities. Students sometimes are upset by an exam, but the student who knows his lesson, and knows that he knows it, is less likely to fail in a stress situation.

The dread of speech-making can be overcome by taking a speech class and applying the lessons.

#### 8. Make your evenings peaceful

"It is during the whole day that you must prepare your dreams," says Dr. Selye, "for if you are subject to insomnia, whatever you do during the day, your next night's sleep depends largely on how you do it. A stressful activity which has come to a definite stop prepares you for rest and sleep, but one which sets up self-maintaining tensions keeps you awake."

Stress produces hormones which key you up. Activities that make for stress should be avoided in the evenings. For better rest, calm down the closer you come to bedtime.

#### 9. Seek solitude

Togetherness isn't everything. Privacy is important for everyone, too. Privacy may be achieved



through a hobby, long walks, listening to music, nature study, or time spent in meditation and prayer. Some have the ability to shut out the world and feel alone even in a crowd or a busy office.

#### 10. Learn how to relax

Do you depend, as millions do, on tranquilizers or alcohol to relax? Says Dr. James P. Hendrix of Duke University: "Present-day living is fraught with tensions and anxieties for many persons, but the everyday use of drugs as relief from these pressures seems unwise. When your work load seems overwhelming, remember that some things can almost always be set aside until later. Concentrate on one particular job. Your work will go faster, and you'll be under less strain."

You may be spreading yourself too thin—trying to do too many things. Relaxation has been called nature's own tranquilizer. Some people know how to relax from birth—others need to learn the art.

This doesn't mean a sudden halt or turning into a vegetable. This can be stressful for some individuals, says Dr. Jerome Tobis of New York Medical College.

#### 11. Watch your emotions

Some people "stew" over things; others get emotionally involved.

Disturbed feelings—anger, hostility, fear, anxiety, insecurity—are caused by our responses, says Dr. Maxwell Maltz. If controlled, they would build a "psychic screen." "Once you have found the secret of relaxation by learning to ignore the conditioned response, you will have a chance to discover the quiet room within yourself that each of us needs—and has. It is my belief that each personality is equipped with a center which, like the deep of the ocean, is never disturbed."

#### 12. Get right with others

Poor relations with people with whom you work or live can keep you in a continual state of stress. Business supervisors know what this costs in employee happiness and general efficiency. In the employes bulletin of the Weirton Steel Company, Weirton, W. Va., are suggestions for soothing stress:

"Give in occasionally—and others will too.

"Do something for others. You'll forget your worries and feel you've

done a good deed.
"Go easy with criticism. Find
another's good points and help him
develop them.

"Give the other fellow a break. Competition is contagious, but so is cooperation."

Stress is not an enemy that needs to be feared, when understanding of what it is and a few sensible rules will harness it. As Dr. Stevenson sums up:

"Tension is an essential function of living, just as hunger and thirst are. But excessive tension is bad. If one recognizes both the good and the bad in tension, he is more likely to employ the good, and to control the bad."



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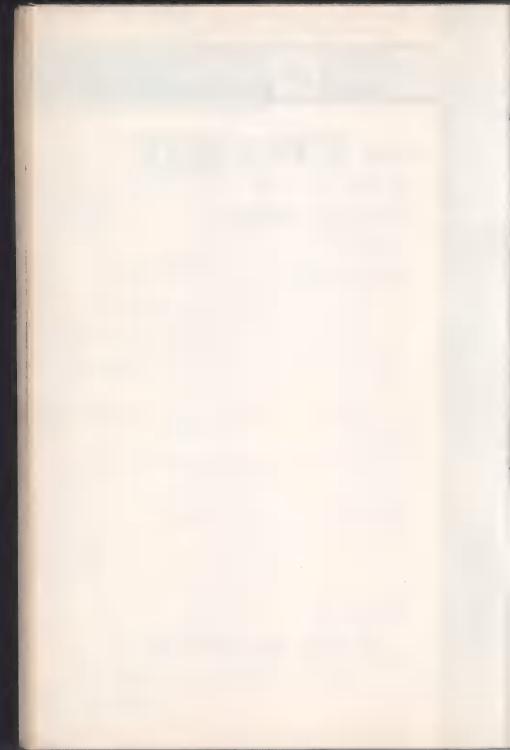
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Tufts University undergrads assembled a model of their proposed prop-jet train.

#### 350-mph train

AKE A 500-MILE tube of concrete. Insert a bullet-shaped vehicle propelled by prop-jet. String the tube from Boston to Washington.

Result: You ride from Beacon Hill to Pennsylvania Avenue in an hour and a half with airline comfort

and railroad safety.

It can be done, financially and physically, say a team of undergraduate engineering students of Percy H. Hill at the Tufts University College of Engineering.

Before "take off" the vehicle. designed for 75 passengers and driven, front and rear, by turboprop engines, sits in the tube on retractable wheels. As it approaches 150 miles per hour the wheels retract and the vehicle "flies," protected from collision with the tube by a cushion of high-pressure air.

Using existing propulsion systems, speeds of 350 mph are possible. New systems, known to be feasible, can reach up to 750 m.p.h.

The timetable from cities to be served, Boston, Hartford, New York, Philadelphia and Washington, provides three types of service -express, semi-express and local. Every-hour express service between Boston and Washington takes one hour. 31 minutes: semi-express service between Washington-New York and Boston-New York, 50 minutes: local service between each of the cities and their nearest neighbor, 28 minutes.

Because the prop-jets will fill the tube with hot, noxious fumes, air conditioners are placed every four miles along the route. The vehicle is pressurized with its own self-contained air treatment system. Stations are designed as giant turntables to move in a half-circle, thus sealing off tubes before passengers move in or out of the vehicles.

Students estimate that if the fare is pegged at \$30 between Boston and Washington, the system can pay for itself in 30 years.

# How electricity in the air affects you

by John R. Free

A three-man research team may have discovered an unsuspected electromagnetic link between you and your environment.

Pooling their skills, a physicist, medical doctor and psychologist in Syracuse, New York, have detected sensitive "electrical circuits" in our bodies which they feel can be influenced by electromagnetic force fields.

Furthermore, the scientists believe a relationship may exist between these "circuits" and studies that have linked suicides, emergency hospital admissions and mental illness with violent eruptions from the sun's boiling surface.

Here's how scientists think the sun may influence us:

Normally our planet is bathed in a continuous "wind" of particles from the sun. These ionized bits of matter are apparently harmless. During the sun's "active periods," however, solar flares become prominent.

These huge, tornado-like eruptions often occur over or near sunspots. Scientists think the upward blast of electrons and protons hurled into space by the flares may tear additional particles loose from the sun's magnetic grip. The placid solar "wind" becomes a hurricane.

In about one day, having completed the 93,000,000-mile journey at a velocity of some 1,000 miles per second, the particles smash into the earth's atmosphere.

#### Trapped by magnetism

The effects are spectacular! As they approach, particles are trapped by the earth's magnetism and accelerated to high velocities. Then, at high latitudes, magnetic lines of force funnel them into the atmosphere.

Gas molecules are excited into shimmering auroral displays of pale green, bright red or faint purple. A geomagnetic storm begins, distorting the earth's magnetism. As the "storm" continues, compass needles may shift several degrees; telephone and telegraph communications are disrupted; high frequency radio bands are blacked out. Fluctuating magnetism on the earth's surface may even blow telegraph



Sacramento Peak Observatory, AFCRL

line fuses by inducing voltages along miles of wire!

Can these storms affect you? The result of some studies is clear: they appear to influence some people. In the 1930's, for example, the German scientists Düll and Düll compared some 40,000 medical cases with 67 magnetic storms that occured during a five-year period. Their conclusion? As terrestrial magnetic storm activity increased, the number of suicides, nervous and mental disease patients also increased.

More recently, Profs. Howard Friedman and Robert O. Becker of the Upstate Medical Center of the State University of New York in Syracuse and Prof. Charles H. Bachman of Syracuse University's physics department have used computers and complex statistical techniques to analyze similar data

The trio used admission data for a four-year period from seven New York State psychiatric hospitals and a Veterans Administration hospital. This provided case histories of 28,642 patients. Magnetic storm data was obtained from a Solar flares hurl particles into space. Many are trapped in the Earth's magnetic field. Geomagnetic storms result, seem linked to a jump in suicides, mental and nervous illness. Traffic accidents zoom 70%.

magnetic observatory in Virginia and the Central Radio Propogation Laboratory in Colorado.

#### Links found

Comparing geomagnetic storm activity and hospital admissions for 7-, 14-, 21- and 35-day periods, they found a definite link between mental illness and the earth's magnetic field.

"The relationship is very real," says Bachman, but stresses that magnetic fields may not be directly responsible: "Electrostatic fields, atmospheric ionization and other correlated environmental factors may produce the effects."

How can electromagnetic fields influence human beings? The Syracuse trio believe they may have found the answer: its effects on our body's electricity, which is generated within the central nervous system.

Scientists believe that electrostatic potentials are associated with all living things. These direct current potentials, like those accompanying flashlight or radio batteries, can be measured on everything—trees,

#### THE EFFECT OF ELECTRICITY

High electrical charging of the atmosphere caused, according to a survey by the World Meteorological Organization:

- Traffic accidents to rise 70 percent over days of low electrical charging.
- Industrial accidents in jump 20 percent over ordinary days.
- · Chronically ill patients to complain of pain twice as much.
- Amputees to double their complaints.

vegetables, salamanders, insects and cats. On the human body these potentials seldom exceed 40 thousandths of a volt.

Using highly sensitive techniques they have developed to measure D C potentials, the Syracuse team found the highest voltages concentrated on the skull, between the shoulder blades and at the base of the spine. Lesser voltages, they discovered, are distributed on our bodies like curved contour-map lines.

Prof. Harold S. Burr of Yale, who pioneered this field, postulated the electrodynamic theory of life in 1935. He proposed that these DC potentials have a controlling function in life.

He was right. Burr's research and studies of others has revealed that:

- Plants regenerate at rates proportional to direct current applied to them.
- Malignant mice tumors gradually disappear when direct current in periodically applied.
  - Schizophrenic's DC potentials

differ from normal persons.

- We fall asleep when direct current is applied to our skull.
- Cerebral cortex neurons, the brain's "gray matter," are influenced by direct current.

#### Bones mend faster

Moreover, Dr. Becker, an orthopedic specialist, found that broken bones were healed more quickly by applying direct current to the mending bone. (Electrical currents near growing bones were detected as early as the 1880's.)

Russian scientists found that patients could be put to sleep or anesthetized, depending upon the amount of current applied to the brain. This process, called electronarcosis, causes an amazing change as the subject "goes under": The voltage on the subject's head reverses polarity!

Normally the front of the head has a negative potential, the rear positive. But a DC generator forces the front to become positive. Result: slumberland. Similar vol-

tage changes take place during hypnosis and normal sleep.

Each neuron in our body, the Syracuse scientists found, is like a tiny battery generating current. This current differs from the "flashes" of nerve impulses that pour into the brain from our eyes, ears and other senses.

As we read, for example, optic nerve impulses travel to the brain as "waves" of depolarization. They are electrochemical in nature and depend upon the movement of free ions. Neural currents, however, appear to flow steadily, like the movement of charges in transistors and other semiconductors.

To confirm this "semiconductor theory" the scientists froze a section of a laboratory animal's nerve. Freezing blocks the movement of sensory nerve impulses. (This begins to take place when we become "numb" with cold.) Instead of stopping, however, the current

increased. This reaction, similar to that of crystal semiconductors, helped confirm their belief that direct current flow within nerve fibers is an organic semiconductor phenomenon.

#### How currents travel

By carefully tracing nerve fiber currents and testing their polarity, the scientists determined how the electrical charges return to their starting point—the nervous system's "circuit." The currents, they found, travel outward along motor nerves and return to their starting point through sensory nerves.

As Burr suggested in 1935 these potentials and currents do influence human behavior. Our brain's organized activity depends upon normal current flow. The Syracuse scientists have suggested in several scientific papers that this neural direct current may be influenced by

#### WHICH IONS DO WHAT

Our response to excessive atmospheric ions depends upon individual sensitivity. Generally, we quickly adapt to changes in ion concentration. Here's how ions may affect us if one type is predominant:

#### POSITIVE IONS

Effects: An irritable feeling, depression, fatigue, dizziness, nausea, rapid breathing and sore throat. (Some subjects, however, have responded favorably to positive ions.)

Where they occur: Heavy air pollution in cities, dust and smoke-filled rooms inhibit negative ions, causing high positive ion concentrations. Warm, dry winds and falling barometric pressure fill the air with positive ions. (The seasonal Alpine foehn and Rocky Mountain chinook are examples.)

#### **NEGATIVE IONS**

Effects: Pleasant feeling of well being; relaxation and sleepiness.

Where they occur: Negative ions may predominate near rain storms and next to waterfalls.

force fields or ions in the air.

Atmospheric ions are clusters of air molecules with a net positive or negative charge. They are generated by cosmic rays, radioactive material in the earth's crust, electrical storms and friction from blowing sand and dust particles. Ultraviolet radiation, which increases dramatically during solar flare activity, is another source.

#### lon concentration

A cubic centimeter of air normally contains from 200 to 1,000 ions of each polarity. This concentration is sensitive to many factors—humidity, dust, temperature, smoke—and under some conditions may reach levels five times or more above normal. Microscopic airpollution particles in cities may boost ion levels to well over 5,000 ions per c.c.

How do ions affect our body? Ionization experts still aren't sure; presently they are studying several possible mechanisms. Professor Bachman recalls accidently leaving a positive ion generator on near his office desk; he soon felt "stuffy" and developed a headache.

Atmospheric ions may affect heart and respiratory rate, basal metabolism and blood pressure. Dizziness, depression, nausea and fatigue have been reported accompanying abnormal ion concentra-

Some studies indicate negative ions are beneficial. They frequently produce a feeling of euphoria or well being. Concentrations of negative ions often form before rain storms, causing a "fresh" feeling in the air. When ants scurry about blocking their tunnels before a storm they may be sensing this increase.

Some hospitals now use negative ion generators to aid in neutralizing pain from severe burns and other injuries. Doctors report the ions reduce local infections, help burns heal faster and reduce the need for numerous skin grafts.

What's being done to regulate these subtle influences upon human behavior? Air conditioning and heating manufacturers now artifically increase the negative ion concentrations in some units. This is necessary because negative ions are attracted to metallic ducts and filters, causing abnormally high levels of positive ions.

The big questions remain: To what extent do magnetic storms influence mass human behavior? Is magnetism itself or some related phenomenon able to generate emotional instability? A few scientists, working at the frontiers of man's knowledge, seek answers to these elusive riddles.

## Negative ions create the 'fresh' feeling just prior to a rainstorm.

## What we're learning about tides in the earth

by Andrew Hamilton

It is well-known scientifically that the moon (and to a lesser degree the sun) causes tides in the ocean. But did you know that the moon also causes tides in the earth?

Like ocean tides, these twice-aday variations in the height of mountains, deserts and plains—up to 12 inches in some places—occur all over the globe when the moon is high. Scientists from UCLA, CalTech, Columbia and other institutions have taken an increasing interest in this phenomenon.

One of America's leading geophysicists, Dr. Louis B. Slichter of UCLA, says, "We are using new and sophisticated instruments to measure the earth tides—thus providing a fresh look at how the earth yields to these forces and how this yielding reflects the earth's internal strength, structure and viscosity."

Both earth tides and oceanic tides result from an interplay of the forces of gravity. A review of what we know about oceanic tides can provide some understanding of these minute gravitational variations (see *Science Digest*, June '65).

As far back as the year 100 A.D., the Roman naturalist Pliny wrote about the moon's influence on tides. A scientific explanation of the tides was formulated by Sir Isaac Newton after discovering the law of gravitation in the 1600's.

The force of gravity is determined by two factors: (1) the mass, or weight, of the two bodies involved, and (2) the distance between them. Gravity decreases as distance increases, and the decrease is according to the square of the distance. In other words, if the distance between two bodies is doubled, the gravitational attraction is cut to one fourth.

Thus, in a contest between the sun and moon, the sun has greater mass but the moon is nearer—this factor being the most important in this relationship. The tide-producing power of the moon is about twice as strong as that of the sun.

In most areas there are two high tides each day. One occurs when the moon is approximately overhead, the other some 12 hours and 25 minutes later when the moon, so to speak, is almost under foot. At first thought, this might seem Dr. Louis B. Slichter checks earth tides recorded by LaCosta Romberg gravimeter.



## Earth tides must be measured indirectly with a gravity meter.

strange. If the moon causes high tide by pulling water toward it when directly overhead, why wouldn't it cause a low tide on the opposite side of the earth at the same time?

The explanation is fairly simple. Attraction between spheres is between their centers. The pull on the near side surface is greatest and the water on earth is pulled in the direction of the moon. The pull on the far side surface is less and the water on earth moves away.

The same gravitational forces that produce high tides on that part of the earth facing the moon and on the opposite side also create low tides around the earth's circumference half-way between the two tidal points. As the earth turns, high and low tides move across its face.

This system is, of course, complicated by the gravitational forces of the sun. When the sun and moon are in such positions that their forces are joined, high tides are higher and low tides are lower. During eclipses, tides are highest of all. When the pull of these two heavenly bodies are at cross-purposes, high tides are not so high, and low tides are not so low.

If all this sounds complicated, it is simple when compared to complexities introduced by the lag in tides caused by the earth's rotation and the depth and configuration of the ocean bottom. As a result,

oceanic tides vary all the way from the more than 40 foot rises in the Bay of Fundy (which acts as a funnel) to less than one-foot tides in Tahiti.

#### World wide study

Although the study of oceanic tides goes back far into history, observation of tides in the earth is more recent. Observations taken by a UCLA research team under the direction of Dr. Slichter during the 1957-'58 International Geophysical Year represented one of the first attempts at a correlated, worldwide study of this phenomenon.

The difficulty of measuring earth tides lies in the fact that there is no unchangeable reference point against which the rising and falling crust of the earth can be charted. It's a bit like trying to measure the rising and falling ocean tide while sitting in a boat in the middle of the Atlantic.

Since there is no way to take direct measurements, geophysicists resort to indirect observations with a highly-sensitive instrument known as a gravity meter—or gravimeter. Commercial versions of the gravimeter are used in oil and mineral explorations.

Basically, the gravimeter is composed of a spring with a weight on the end of it. When gravity increases a bit, the weight pulls a little more on the spring and it stretches out slightly. When gravity decreases, the weight becomes a bit less, and the spring contracts somewhat. By measuring the change in length it is possible to determine the gravitational force at the moment.

Actually, the gravimeter is not quite that simple. Instead of permitting the weight to fall as gravity increases, the instrument has an automatic system of keeping the weight in a central position. The instant it moves, a photo-electric eye activates an electric motor which moves the other end of the spring-returning the weight to its original position. The number of turns of the motor indicates the distance the end of the spring had to be raised or lowered as a result of the change in gravitation. From this, it is possible to compute the gravitational change itself.

#### Precision is vital

Extreme precision is necessary because the maximum variation in gravity is only three parts in 10,000,000. The gravimeter notes this tiny change with an error of not more than one half of one percent—in other words, the measurements are accurate to about one part in 1,000,000,000.

Although the gravimeter is sensitive, it is by no means lightweight equipment, weighing 640 pounds. During the IGY, it was quite a trick to move this mechanical monster to observation posts around the

world—Wake Island, the Philippines, Vietnam, India, the Sudan, the Azores, Bermuda, the Congo. Such widespread locations were chosen by Dr. Slichter and his associates to provide reasonable coverage of the earth as a whole. Some were in the middle of continents, while others were near the seashore or on mid-ocean islands.

Dr. Edgar A. Kraut and Dr. Ronald Forbes of the UCLA research team started around the world in opposite directions—each with one of the heavy instruments. They travelled by Military Air Transport planes as much as possible, but occasionally commercial airlines. At each station they spent a month taking measurements, then moved on to the next post.

A relaxation of customs barriers during the IGY helped in moving the equipment, as did the cooperation of foreign scientists. Even so there were difficulties. Drs. Kraut and Forbes had planned to meet in the Belgian Congo on March 21, 1958, to take observations at the vernal equinox from an equatorial station. Astronomical conditions prevailing at that time would not be duplicated for another 1,400 years.

For a time, it appeared that neither would be on hand. Both were stranded in Khartoum, in the African Sudan, with no transportation to take them to the Congo. After considerable negotiation, Sudanese officials agreed to find air space—provided the scientists didn't object to joining a barnstorming tour of local politicians

campaigning for election. The two UCLA scientists finally reached the Congo after layovers at such political whistle-stops as Wau, Malakal and Juba.

In spite of such tribulations, the geophysicists were able to complete their observations, punch the results on thousands of IBM data cards and analyze them in an electronic computer.

What is the present geophysical

picture of the earth?

1. The earth has a fluid core—a mixture of iron-nickel—whose diameter is approximately half that of the earth itself.

2. The solid mantle surrounding this core is about as rigid as steel, but over millions of years may behave more like a plastic material and can be permanently deformed by the tremendous forces acting upon it.

3. Tides—both those in the ocean and on land—slow the rotation of the earth and a subject of current and future study is to find out how much.

4. Some say that the gravitational pull of the moon and sun may play a role in triggering earthquakes and building mountains, but this is a theory still unproven.

"We still have much to learn about the earth and its sister planets," said Dr. Slichter. "Geophysics is a young science offering unlimited opportunity for young people with curiosity and imagination."

"This looks like one time when he's going to need more than his 'trusty ole screw driver."





New York Zoological Society Photo

The European bison (or wisent, as it is sometimes called) is the only close relative in the American bison and resembles it closely. It is taller and not quite so heavily built.

### Return of the mighty bison

Until recently, all that remained of the millions of bison that had once wandered through the forests of Europe were a few animals in zoos.

by Dal Stivens

In a world where so many animals are threatened with extinction, it's good to be able to report that one apparently doomed creature has been rescued. The European bison has returned to the forest. This success has only been achieved, moreover, by international cooperation. A herd of 98 European bison (Bison bonasus) has recently been released in a forest on the border of Poland and Byelo-Russia. It is proposed to turn part of the Bialowieska Forest back into its primeval state so that the European bison (or wisent, as it is sometimes called) will flourish as it did

before man hunted it almost to extinction.

It is fitting that the bison should return to the Bialowieska Forest because this was their last wild stronghold until about 40 years ago when they were reduced to a few small scattered herds in European zoos.

The wisent is the only close relative of the American bison (Bison bison) and resembles it closely. It is, however, taller and not quite so heavily-built. It has not such a pronounced slope from the shoulders to the hind-quarters and its tail is longer and more hairy. Unlike its American cousin, it does not range the plains but prefers the forest. It was once widely dispersed over

## In 1923, European bison topped the list of animals headed for extinction.

most of Europe. Until the sixth century forests covered most of Europe; from then on they began to be chopped down to make way for agriculture with the inevitable reduction in the bison numbers.

Nonetheless, the bison was relatively safe because the ruling princes of Europe had strict laws to protect game—some brought the death penalty. Then came great social changes, and by the end of the eighteenth century, the main home of the wisent was the Bialowieska Forest where their numbers were estimated at between 300 and 500.

With the first partition of Poland, the Bialowieska Forest became the private hunting ground of the Russian Czars and enjoyed their protection for over a century.

Their numbers remained relatively static until World War I. This was once attributed to inbreeding, but it is now thought to have been due to the increase in competition for grazing from vast herds of red, fallow and roe deer. Modern research has shown that both the European bison and American bison need the best quality food to survive.

World War I brought disaster. During the first three years, the number declined rapidly because of poor food. They were reduced to about 200. Then during 1919-1920, German armies retreated from the

Eastern Front through the Bialowieska Forest where they were engaged by the Lithuanians. Further severe fighting came in this area between the Bolshevik armies and the Poles. When peace came, not a single wisent remained alive in the forest. The last wild bison in the Caucasus had also been killed.

#### **Nearing** extinction

All that remained of the millions of bison that had once wandered through the forests of Europe were a few animals in zoos and private sanctuaries, such as the Duke of Bedford's Sanctuary at Woburn, England.

The European bison was on the top of the list of animals in danger of extinction when an international meeting was held in Paris in 1923 to consider ways of conserving the world's vanishing wild-life. Jan Sztoleman. a Polish naturalist, founded an international society for the protection of the European bison. Its first task was to take a census; in 1932, the Society published the first Pedigree Book of the European Bison. Only 30 bison were admitted as pure-bred animals. A number of others were excluded because of cross breeding with the American bison. They were in small herds in Britain, Germany, Holland, Poland and Sweden.

The Poles, who had lost all their bison, acquired two cows and a bull from a German zoo in 1929 and started a breeding herd. Elsewhere, zoos and sanctuaries embarked on a program. Thereafter the build-up was very slow. By the beginning of World War II, the European total was under 100. The bison were soon seriously threatened because only those in Sweden were outside the war zone. However, the European bison survived this war rather better than was feared, and the 1947 edition of the Pedigree Book listed 98. By 1955, 200 were listed.

Even so, there were grave dangers because in 1953 the Polish stocks were almost completely wiped out by a severe outbreak of foot and mouth disease. As an insurance against epidemics which might destroy a whole herd, other breeding centers have been established in Russia, Bulgaria, Denmark, Austria and Czechoslovakia.

The bison herd in the Bialowieska Forest is queened over by an elderly female. Cows, much like hens, have a social status ranking which is established by brawn and bluff. Cows with their calves keep together and the matrons are so formidable that wolves and the large wild cats, the size of panthers, are afraid to attack them. So aggressive are the breeding females that they have been known to drive off even birds if they approach too closely.

#### Boars for company

There is, apparently, safety in being reasonably close to the matriarchal society of bison. In the Bialowieska Forest, other animals, particularly wild boars, keep within a modest distance of the bison mob in order to achieve some security from wolves and the wild cats.

The males, too, have their own society with a social order according to how big and bold they are. The only mixing of the sexes comes at the beginning of the breeding season, which extends from July to September. The calves are born the following spring.

There's some poetic justice in the fact that the newly returned bison have recently taken to attacking human beings. They are particularly enraged by motor cyclists and pursue them hotly. It seems reasonable after what man has done to him.



#### Sea colonies

Two divers who spent two days and two nights 432 feet deep in the Atlantic Ocean predict that human colonies will someday tend ranches on the bottom of the sea. The men spent 49 hours in a rubber house inflated with gas at 14 times atmospheric pressure. They breathed a mixture of 3.6 percent oxygen, 5.6 percent nitrogen and 90.8 percent helium. According to diver Robert Stenuit, "Our ancestors will stay in the depths even longer than we did. They will colonize the sea floor, and cultivate its resources instead of pillaging them."

### Science gets serious about

### E. S. P.

Recently, extrasensory perception has been drawing the attention of scientific societies and universities. Its study may or may not yet be exactly a science, but there is a tendency to call ESP possible.

by Daniel Cohen

ON AUGUST 31, Dr. J. B. Rhine, grand old man and patron saint of American parapsychology, ended his nearly 40-year association with Duke University, in Durham, N.C.

But retirement from Duke has not ended Rhine's career in parapsychology nor will the doors of his famous and controversial Parapsychology Laboratory be closed. Dr. Rhine is now executive director of the Foundation for Research on the Nature of Man (FRNM). For the next few months at least, FRNM will operate out of the old Parapsychology Laboratory facilities in the West Duke Building, Meanwhile, FRNM will build its own headquarters, probably somewhere in the Durham area. All the facilities and records of the Duke laboratory will be transferred to it.

According to Rhine, FRNM will

encourage research into those properties that distinguish man from his physical environment yet lie outside the scope of orthodox science. At the core of FRNM's work will be parapsychology, which Rhine feels is the most organized of the unorthodox sciences. Head of the parapsychology department will be Rhine's wife and long-time coworker. Louisa.

Parapsychology, extrasensory perception (ESP), "psi" (for psychical) phenomena are all terms used to describe that group of unexplainable happenings ranging from hunches and premonitions to contacts with the spirit world. For nearly 40 years, Rhine's great task has been to try to bring some sort of scientific order to the study of these occurrences.

How well has he succeeded?

ESP is still a long way from being recognized as an established



Dr. J. B. Rhine began 40 years ago to bring scientific methods of study to ESP. He managed to make ESP a respectable subject for scholarly speculation, tests.

fact. A survey of American psychologists showed that only a small percentage considered the existence of ESP proven. But the same survey showed that over the years there has been a growing tendency to accept ESP as a possibility. This tendency was particularly strong among young psychologists.

Rhine is principally credited with making ESP a respectable subject for scientific discussion. Prior to the Duke studies, parapsychology was regarded strictly as crackpot stuff by most orthodox scientists. Investigations were in the hands of ama-

teurs interested in spirit mediums and ghost chasing or in just collecting accounts of strange "psi" events. Rhine and his associates have also, from time to time, been interested in mediums and ghosts and they still collect stories of "psi" experiences. But they have been able to get part of the research out of the darkened seance room and into a well-lighted laboratory.

Recent events are indicative of ESP's emerging respectability. In June, a two-day conference on "Extrasensory Perception, Fact or Fancy" was held at UCLA, and in



If you guessed the star, you're right! For a full evaluation of your ESP ability, see Dr. Rhine's four-ace test on page 71.

## Some enthusiasts said Soviet ESP research would create a U.S. lag.

October, Rhine was invited to lecture on ESP by the British Association for the Advancement of Science as part of their Guildhall Lecture series.

#### University connection

Although the Duke laboratory was the only university-connected parapsychology research institution in the U.S., there are from 30 to 40 other scientists who have conducted extensive individual investigations. Among the leaders are Dr. Gardner Murphy, former head of the psychology department at City College of New York and now director of research for the Menninger Foundation, and Dr. J. G. Pratt, Rhine's former assistant, now on the staff of the University of Virginia.

Rhine believes that acceptance of ESP is growing "more widely than intensively. It spreads around the world. One is more accepted in foreign countries than in one's own. I think that is probably true here in America. America is a conservative, somewhat conventional country."

Actually, the position of parapsychology in relation to orthodox science is about the same all over the world. There are only a few university-connected laboratories. The oldest is at the State University of Utrecht in the Netherlands, the newest at Andhra University in India. Most research is carried on

by interested individuals, many without scientific training.

Russia also has one parapsychology laboratory is new but it is headed by septuagenarian Dr. Leonid L. Vasiliev, one of the pioneers in the field. The extent of Soviet ESP research has been exaggerated by some enthusiasts in an attempt to create the idea of a "parapsychology gap." The cold war competition, they hoped, would do for ESP what it has done for space research.

Most of the experiments by Rhine and his staff at Duke have been conducted in four areas: Telepathy, the ability to be aware of the thoughts of another person. Clairvoyance, the ability to mentally "see" an event without being near it physically. Precognition, the ability to be aware of an event that has not yet happened in time and psychokinesis (PK), the ability to influence physical objects with thought.

To Rhine, all these abilities are different manifestations of one basic and unknown process. Indeed, while making tests, Rhine devised elaborate procedures to establish just what ability he is testing. As an example of some of the pitfalls, consider the simple test on our cover. If you guessed the correct symbol (or made a "hit" on the target symbol, to use parapsycholog-

ical jargon) it perhaps was due to chance; the odds were one in five. But for the sake of illustration, let us assume you guessed correctly because of ESP. Now, which kind of ESP ability was responsible—clairvoyance or telepathy?

#### Distance doesn't matter

Clairvoyance seems the most obvious, that is, you "saw" the answer before you ever opened the magazine. However, a hit could also be attributed to telepathy, because you might have been "tuned in" on the mind of the writer or someone else connected with Science Digest. or with some other reader who has already seen the answer. Since all ESP abilities are assumed to operate undiminished over any distance, it didn't matter how far away you were from someone who knew the answer. Precognition is still a third possible explanation. While thinking about what guess to make, you might have "seen" the future time when you would physically open the magazine and look at the answer.

If you were taking a test with the symbols printed on cards, which is the way formal ESP tests are given, PK could become a factor, since it might influence the order of the cards in the deck during shuffling. However, PK is generally tested by attempting to influence the fall of dice.

Rhine believes that everyone has ESP ability, but that it is more developed in some. He was the first to conduct exhaustive tests on a large number of ordinary people, usually Duke students. Most significantly, he encouraged the use of orderly statistical methods in ESP research.

"Statistics," Dr. Pratt has written, "provide an objective index of an effect which would otherwise remain vague and questionable."

Most of the people tested in the parapsychology laboratory scored at chance or near chance levels (that is calling an average of one out of five cards correctly). Some scored slightly above chance over a long period. There were also a small number of "stars" who scored well above chance, nowhere near 100 percent, but the difference seemed statistically important. Rhine's best subject was Hubert Pearce, a Duke divinity student. In one "crucial" experiment, there was a series of 300 trials. By chance, correct guesses should have been made 60 times, but Pearce made 119.

#### Methodology attacked

When Rhine published his early results, his methodology was immediately attacked by many scientists. They said that experimenters could give subjects a variety of unconscious sensory clues. They even pointed out that in some cases the symbols were so heavily printed on the cards that it was possible for the subject to see them even when the card was turned face down.

Conscientiously, Rhine attempted to eliminate sources of error

## Positive atmosphere and attitude are vital for good ESP scores.

from his procedures, and as he did the scores of his subjects fell, although the "psi" effect did not

entirely disappear.

Parapsychology supporters insist that one of the reasons for this decline was that rigid, mechanistic controls disrupt the subtle ESP effect. Says Rhine, "Elaborate precautions take their toll. Experimenters who have worked long in this field have observed that the scoring rate is hampered as the experiment is made complicated, heavy and slow-moving. Precautionary measures are usually distracting in themselves."

Some ESP researchers even object to the statistical methods used by Rhine. They find these restraints stifling and prefer the old qualitative approach, which concentrates on studying dramatic but

uncontrolled psi events.

All tests indicate that atmosphere and attitude are vital for good ESP scores. If both the subject and the experimenter believe in ESP the scores are more likely to show an ESP effect than if one or both are skeptics. Skeptical psychologists have their skepticism confirmed by being unable to get good ESP test results. In addition, not even the best subject ever scores high consistently. The number of hits tends to decline toward the chance level the longer the experiments continue. Rhine speaks of ESP as being "in-

credibly elusive."

This elusiveness means that experimental results can not be duplicated at will, and this presents a major stumbling block for ESP. A basis for determining the validity of any scientific experiment is that the results can be duplicated if the experimental conditions are reproduced.

#### Scientists suspicious

Many scientists are also suspicious of experiments that work only for believers. Ruling out deliberate fraud, skeptics say that errors in recording test results always occur. and that people tend to make errors that support their beliefs. In 1952, Richard S. Kaufman at Yale University made some PK tests in which he employed eight recorders to take down the results. Four of these recorders believed strongly in PK, the other four did not. Unknown to the recorders, a hidden camera was keeping track of the results of the test, too. The camera showed that the real results conformed to chance. The four persons who believed in PK made errors that supported its existence, the four disbelievers made the opposite kind of errors.

Aside from recording errors, a number of general statistical objections have been raised to ESP tests: 1. Only the successful tests are reported. Although laboratories like the one at Duke keep the results of all tests, only the ones that tend to prove ESP get any publicity. Among independent experimenters, those who do not get good results simply quit or do not publish their results. Thus, trying to figure the odds against one subject's making a run of high scores is a very tricky business, since the total number of projects is unknown.

2. Are the test cards really arranged in a random fashion? Cards are often not shuffled but arranged in accordance with published tables of random numbers, but mathematicians have pointed out that even these tables are not sufficiently random to assure a chance level of guesses. Some ESP researchers agree that this criticism may invali-

date those tests that show only a small nonchance effect, but that it can not explain the small number of very high scores.

3. There are too many ways of interpreting the statistics. In one of the most famous ESP experiments of the 1930's, London mathematician S.G. Soal used a card-guessing technique on 160 subjects over a five-year period. He recorded some 100,000 guesses and, at first, found no evidence of ESP. Later he was persuaded to reevaluate all his records to see if there was any displacement effect, that is the guessing of the card ahead or the card behind the target card. Looking at the figures this way, he found two subjects who scored abnormally high in guessing the card one or two ahead of the target.

When scores fall abnormally low,

A clairvoyance test includes such controls as not touching the cards. Other types of ESP abilities tested are precognition, the ability to be aware of an event that has not happened, and psychokinesis, the influencing of physical objects through thought.



## Subjects with unusually low scores may be "unconsciously rebelling."

this is regarded as negative form of ESP. Rhine calls it "avoidance of the target" and sees subjects as "unconsciously rebelling" against the test.

### **Objections**

Critics complain that if one can choose between all the possible variations, there is a strong likelihood one of them will show a non-chance effect. They quote Aristotle, who wrote that it was probable that the improbable would sometimes take place.

But there is another side to these objections. Parapsychologists say that if you look deeply enough into the methodology and statistics of any experiment, you can find objections if you want to. They believe, with some justification, that many of their experiments are more tightly controlled than are experiments in allied fields.

Social scientists Bernard Berelson and Gary A. Stiner, in *Human Behavior*, their inventory of scientific findings, wrote of ESP experiments, "Judged by the scientific standards ordinarily applied in other areas of psychology, the evidence is often persuasive."

The reason scientists refuse to apply ordinary standards of proof to ESP is that such an effect simply does not fit in with what we know about the physical world. Says

psychologist Ernest R. Hilgard, "To demonstrate something highly implausible requires better evidence than to demonstrate something plausible. The reason is that supporting evidence for the plausible finding comes from many directions, while the implausible one must hang from the slender thread of nonrandomness until certain systematic relationships are found that tie it firmly to what is known."

Why is ESP so physically implausible? On the surface, telepathy, at least, seems quite plausible. It is well known that the brain generates electrical energy, just as a radio transmitter does. But there is no evidence that these waves are strong enough to be picked up by another person's brain, and there is considerable evidence that they are not. In addition, there is no structure in the brain which seems even remotely capable of receiving and amplifying another's brain waves.

A more basic objection to telepathy, and in fact to all forms of ESP, is linked to the repeated observation that distance seems to have no effect on them. All known physical radiation varies in intensity as the square of the distance from the source. Rhine acknowledges this objection. In his Guildhall lecture he stated, "Had psi been even half plausibly explainable by a radiation principle, it would now be in first-

rate standing among the established sciences."

When it comes to precognition, most scientists simply throw up their hands in dismay, for to account for this ability to "see" the future we would have to live in a universe in which all events, down to something as minor as the shuffling of a deck of cards, is completely predetermined. All ideas of chance and free will would have to be discarded.

#### Rhine's reasons

These far-reaching implications don't bother Rhine one little bit. They are, in fact, the reason he went into ESP research in the first place. At one time, Rhine had considered a career in religion, but he turned to ESP as a field in which he could combine his scientific training (he is a graduate biologist) and his broad religious and philosophical interests.

In his London lecture, Rhine made the point that psi was an unknown nonphysical force. "Naturally, all this has a bearing on materialist theories of economics and political affairs that are currently popular in some parts of the world. But it bears equally on mechanistic theories of medicine, biology, and psychology that generally prevail. It liberates these sciences from the confinement of a materialist metaphysics by introducing for the first time a scientific test of the materialist hypothesis that all human agency is adequately explainable by exclusively physical principles." To Rhine, psi is an integral part of all supernatural religion. But he expects even less support from organized religion than he has received from organized science. "It is in the very nature of orthodoxy not to welcome, let alone support, an experimental invasion of the domain of authority and faith," he said.

Still, one does not need a religious or supernatural outlook to believe in ESP. Russia's Vasiliev is a strict Marxist materialist. In a recent English edition of his book Mysterious Phenomena of the Human Psyche (University Books, New York City, \$6.00), we find this statement: "So long as religion exists, so long will superstitious notions, incompatible with attainments of science, remain secreted in the minds of some men and, from time to time, spring to life again. Our task is to remove the aura of mystery from phenomena that give rise to superstition; to explain them scientifically."

"ESP," comments Martin Ebon, administrative secretary of the Parapsychology Foundation, "is like a stew. If you like meat, you can pick out the meat. If you like vegetables, you can pick out the vegetables. If you like only broth, you can skim that off, too."

The meatiest, or perhaps gamiest, area of parapsychology surrounds the activities of the professional mediums, clairvoyants and fortune tellers. Oracles and diviners once played a much more important part in history than they do today, but

## Fortune tellers and mediums will seldom submit to laboratory tests.

the belief that there are persons gifted in seeing the future, or getting in touch with the dead, still persists. The usual parapsychological term for such persons is "sensitives."

Serious parapsychologists don't do much work with sensitives, particularly professional ones. Some researchers reject them entirely. Characteristically, Rhine takes a cautious but tolerant view.

In an interview with National Educational Television, he said, "We take them all as individuals and test them if they are willing to be tested, as to what they can do under laboratory conditions. We've had a medium in the laboratory for careful study, and she was a very good performer in some tests. But not many are willing to come to the laboratory. For the most part, I think they are probably afraid the tests would be too severe for them."

Prof. W. H. C. Tenhaeff of the University of Utrecht has worked extensively with the highly publicized Dutch clairvoyant Gerard Croiset, and researcher Andrij Pugharsh has tested another well-known "crime-solving" psychic, Peter Hurkos. On the surface, the exploits of such men look immensely impressive. Upon closer examination, however, their predictions seem irritatingly and unnecessarily vague. Supporters claim that they

have been subjected to rigorously controlled tests of their ability. But the tests are too often dramatic rather than scientific.

### Prima donna qualities?

Is the elusiveness of some professional sensitives due to the prima donna qualities of a great artist? Is it because the cold laboratory setting destroys the delicate ability to see the future? Or is it a deliberate evasion to avoid exposure as a fraud? You can take your pick of reasons.

Telepathy, clairvoyance, precognition and PK are not the only manifestations of psi phenomena that have been studied. Rhine has looked into ESP abilities of animals, Pratt has chased poltergeists and the Russians got their fingers burned testing women who said they could read with their fingers.

How about life after death? Says Rhine, "We can't claim that we've had a successful investigation of that. We began very seriously on it but found there's no way we can pin it down. We have had to leave it as one of those things that can't be decided by any method we know."

Anyone trying to predict the future course of ESP study is warned that past predictions have been notoriously lacking in precognition ability. In the early 1900's, the great American psychologist William James said that "psi" investigation would be the most important part of psychology in the decades to follow. This certainly has not proved to be the case.

On the other hand, increasingly tough laboratory tests have not eliminated the slight but intriguing statistical evidence for ESP.

Menninger's Dr. Murphy doubts that any experiment will ever prove parapsychology or make it scientifically acceptable, "until psi gets a conceptual theory that fits."

Rhine sees ESP as an already established young science. He compares it to the state of the physical sciences in the 1800's when scientists were aware of natural forces like electricity or magnetism but not able to really understand them.

Across a vast gulf of disagreement and often hostility stand ESP's irreconcilable scientific opponents. Their position was summed up bluntly in Science by Dr. George R. Price of the University of Minnesota. "My opinion concerning parapsychologists is that many of them are dependent on clerical and statistical errors and unintentional use of sensory clues, and that all extra-chance results not so explicable are dependent on deliberate fraud or mildly abnormal mental conditions."

Is that all there is to it? To the parapsychologists, this explanation is too pat to cover the thousands of good results they have obtained. To the public, it is a dreary and disappointing explanation for some very exciting events.

One's ultimate attitude toward ESP today must be shaped by his prejudices. This is not a very scientific way to resolve a question, but the evidence is still so ambiguous that preconceived notions will not be overwhelmed by facts from either direction.

### DR. RHINE'S 4-ACE TEST FOR ESP

It is QUITE easy for anyone to test himself for ESP ability. The easiest type of ESP for self-testing is clairvoyance, or the ESP of objects, such as cards.

Any cards that come in packs for games would do, but the standard playing card pack would be most available.

Begin by taking out the four aces and laying them on the table in a row, face-upward. Then take the other 48 cards, shuffle them, with only the backs visible; keeping them face down, ask yourself which ace the top card will match for suit. Do not look closely at the backs of the cards but focus, rather, on the four aces and one may seem a little different to you as indicating the one that the card in your hand matches. Lay it down, still keeping it face-down.

Now do the same with the next

card, and keep on until you have placed all 48 of the cards. Pay no attention to the order and avoid falling into any kind of rhythm or patterning. Simply take each card by itself and ask, 'What is the suit of this card?' Use any hunches or intuitive feelings you may have. Follow the impulse that comes first to mind or seems to draw your hand with the card in it. Each one should work out his own method, for it is largely an individual matter as to how one will do his best. Avoid having people around who will distract your attention. Take the test seriously, if you are serious about wanting to know about your ESP ability.

When all the cards have been laid down, turn them over, one pile at a time, and see how many hits you have made. Make a record of each such run through the pack; then keep a record of all your scores.

Now, by chance, you should get, on the average, twelve hits out of the 48 cards. If you care to do only one run through the pack, you had bet-

Prince:

"According to their log book, they sailed over the edge of the earth!"

ter not conclude that you have demonstrated ESP ability, unless you get 20 or more cards right in the run. But if you are willing to do 10 such runs through the pack, you would need only to average 15 hits per run, which would give you a total of 30 hits above the average expected for 10 runs, or 120, in order to show rather definitely that you have this type of ability.

In a laboratory test you would not be allowed to see the backs of the cards because there might possibly be some sensory cue that would identify the card for you. But for your own self-testing, you would naturally avoid using such cues and would not concentrate on the backs of the cards anyhow.

For those who want to use the standard test cards, which were devised at the Duke Laboratory, and which are still available there and in many other parts of the country, instructions will be found with the pack of cards, which show how a number of types of ESP tests may be conducted, and references may be obtained to books which will give more extensive instruction for a wider range of types of tests and for more of the mathematical methods used in weighing the results.

Packs of standard ESP cards can be obtained from Haines House of Cards, 2465 Williams Ave., Norwood, Ohio 45212. The cost is \$1 a pack plus postage. Pads of scoring sheets cost 25 cents. Further information on ESP tests or on any aspect of parapsychology can be obtained from Foundation for Research on the Nature of Man, Box 6847, College Station, Durham, North Carolina 27708.



### Make believe for real

Computer models can now forecast what will happen in a war manuever or business move.

by Stanley L. Englebardt

RECENTLY I watched an entire division of U.S. Marines helicoptered from convoy to enemy beachhead within a period of 90 minutes . . . human blood react suddenly and violently to a new, untested drug . . . a major suspension bridge collapse under the load of a traffic jam . . . and a department store built, operated and then torn down on all four corners of a major intersection to see which location provided the best potential.

Obviously none of these things happened in real life. They would be too costly in terms of dollars, time, material or lives. Yet through the technique of simulation we can do the next best thing: build a symbolic model of the object or system, and then put it through its paces to see what will happen in actuality.

Model building has long been a favorite American pastime. Today, however, it is equally popular—and far more profitable—in science and industry. Instead of plastic parts

## Computer simulation can study complex problems cheaply, without risks.

and glue, engineers, researchers, doctors and businessmen use numbers. These numbers represent the parameters and characteristics of the model. Then by subjecting the model to various other numeric loads—the strain on the cables of a bridge, the flow of traffic in front of a department store, or the entry of a new chemical into the bloodstream—they are able to see what effect it will have on the overall system. The result is the ability to study large, complex problems at low cost and without the tremendous risks inherent in real life testing.

The concept of simulation is neither entirely new nor unique. Perhaps its most familiar form is in the wind tunnel or water tank testing of physical models. By scaling down an airplane's fuselage or a ship's hull, and then subjecting the model to equally scaled down wind or water forces, we can get an idea of how it will behave under actual conditions.

But no matter how carefully these models are built they provide answers only to a fraction of the overall problem. The form of a new airplane may prove to be aerodynamically stable at speeds of 1500 mph, but what of the stresses and strains on structures inside the craft? And how will the pilot of that craft react as he hurtles through the atmosphere at more

than twice the speed of sound?

These are questions which are answered being mathematical simulation. Instead of testing out just a few parameters (which, after all, may be all that is under certain stances) we can now literally include every factor which might be present in the real-life system. Even more important, we can build models-and then use them to simulate real-life actions—of virtually any object or system which operates under rules and interrelated elements.

### **Everyday** event

Simulation is something most of us do day in and day out. Take the housewife who feeds a large family on a small budget. Although she sees things intuitively, the parameters of her model are well established: six mouths to feed: 42 individual breakfasts, 42 dinners and 14 lunches (some kids eat at school) every week; a food budget of \$45. Aside from these fixed conditions she must consider: the individual likes and dislikes of her family; the need for menu variety and balance; and the random possibility that the budget will have to cover guests on one or more occasions.

Her problem, of course, is "what to buy?" This is where simulation begins. She picks up the morning paper and notes that the local supermarket has a special on haddock fillets. At  $49\phi$  pound she can get a lot of mileage out of her budget by serving fish at one or more meals. But is this really such a bargain?

### **Balancing factors**

Using her intuitive model the housewife may mentally "cook and serve" the haddock to her brood. The youngest, she knows right away, won't touch it. Thus almost immediately she has a "no" or "—1" value. Two of her children are strictly so-so about fish, and these might be classified as "O." Her husband will spend most of his time searching for bones; another "—1." Only she and her oldest will really enjoy the fish and are worthy of "+1" value.

Of course our housewife sees these reactions only in the familiar terms of "Johnny" and "fish" and "supermarket" and so forth. Yet if she wanted to run out the problem mathematically, she would have all the elements at hand. Even such emotional factors as "like" and "dislike" could be handled statistically.

The parameters of the model used by the housewife, and the rules under which it operates, are relatively few. They can be easily retained and manipulated within the mind. As we move into the realm of science and industry, however, this is no longer the case. And if we are going to simulate here, we

need some additional tools.

Perhaps the most common "tool" in business is the English language. If we can adequately express the system under study we are, in effect, modeling it. One example of this is the business report. The boss may call in one of his managers and ask for "a written summary of our present market situation." The product involved might be automobiles, insurance, steel, petroleum or even left-handed screwdrivers. It really doesn't matter. In any case he will need a basic amount of data.

### Necessary data

He'll certainly need to know the current sales, inventory position, the number of items in production, raw materials on hand and the sales backlog of his own firm. He'll also be interested in an estimate of present and future consumer demand; how well his competitors are doing; how much of the market his own firm has captured; and any national economic trends which may have developed. Finally, he'll need information telling him how his company's products compare with the competitors' in price, style, special features and reliability.

When all of these things are put down on paper they represent a descriptive model of the company's marketing position. With this model the boss and his executives can simulate various things: What will a 10 percent price reduction do to this picture? How much of a sales jump can they expect from the decrease? And so forth.

At this point we are just a step away from symbolic or mathematical simulation. But it is a big step! And in order to make it chances are you'll need a computer.

### **Multiple Factors**

With a computer in the picture the scope of simulation broadens tremendously. At the Vertol Division of Boeing Aircraft, for example, a model was constructed recently to demonstrate the cost feasibility of using a certain mix of helicopters to move a Marine division from ships to enemy beachhead. To do this the firm combined a war games problem (another form of simulation exercise) with a cost effectiveness study. A geographic coordinate system was used to describe the physical layout of the "battlefield" area, including the location and movement of aircraft carriers, the topography of the enemy terrain and similar factors. Other elements of the model concerned the speeds of helicopters under varying load conditions, the effects of wind coming in from several different angles, and the possibility of using evasive routes.

Normally, programming such a simulation for a computer would be an extremely complex and tedious job. In this case—as in most other forms of simulation today—the chore was minimized through the use of a programming language.

Programming languages allow

the user to state the elements of his model in familiar industrial or scientific terms. Then the computer itself, through the intermediary of the language, translates these parameters and characteristics into specific machine terms.

In the Vertol simulation the computer "moved" helicopters from block to block according to timing information and other logical rules expressed in the model. In this way they were able to determine the time needed to accomplish a mission of this magnitude; an optimum schedule for launching and receiving aircraft without any "sitting duck" build-ups or hovering over the landing areas; the cost of using various mixes of helicopters; and the cost per ton of delivering men and equipment to shore.

### Man job

It is evident from these results that the model was an extremely complex one. Yet the major problem in this exercise was not the model itself (which was set up primarily by the computer language) but gathering enough information to make it realistic. This is a man job—not a machine one.

If we can simulate the movement of helicopters between ship and shore, why not the air traffic flow over a major airport... the vehicular flow through a city... the chemical flow through a refinery... the product flow through a warehouse... or even the thought flow through the human mind?

Actually all these things are being done today. The Federal Aviation Agency, for example, utilizes a model of all airfields and navigation aids in the New York area to see what can be done about present congested conditions. The airfields and aids are represented in the model by geographic coordinates; air traffic is represented by plane identifying numbers and changes in coordinates; future traffic is accounted for by statistically expanding these figures; and converging flight plans are used to represent peak periods. In addition, to represent the possibility of pilot error, the computer is programmed to occasionally take the wrong actions and violate the rules expressed in the model. In this way,

accidents, near misses, traffic jams and ground delays are realistically added to the problem.

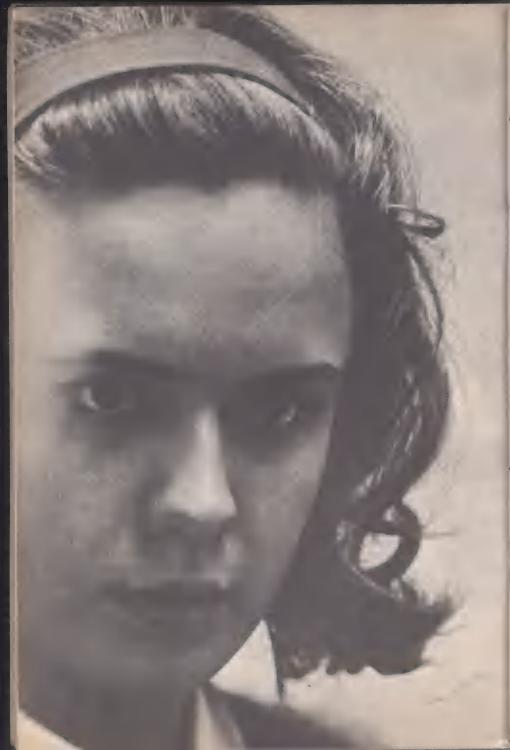
In short, as long as man can define the problem, he can model it. Thus simulation becomes possible under almost any condition.

### Not Foolproof

Simulation is not a foolproof technique. It is a tool—and like all tools its effectiveness is dependent on the skill of the user. Yet judging from the hundreds of models already built, the hundreds presently under construction and the still hundreds more planned for the near future, it is a skill not too difficult to learn. There's little doubt that simulation is here to stay.

That's strange . . . the drug should have taken effect by now."

Science Digest-November, 1965





Faculty-student relationship is close in humanities classes as well as in science labs. Here a student listens to Dr. Conrad P. Homberger, author and modern languages professor.

### Big, little Brooklyn Poly

THE school is a sleeper. It occupies a former razor-blade factory in downtown Brooklyn, across the East River from the towers of Wall Street. It was founded in 1854 as a prep school and junior college. To the unknowing, it's still that.

But Polytechnic Institute of Brooklyn in 10 years has given out more M.S. degrees in chemistry than any other U.S. school except Columbia. In chemistry Ph.D's, it's topped only by M.I.T. and Columbia. And in advanced degrees in X-ray crystallography, it ranks No. 1.

Lecture-rapt Joan Horutz is one of 65 women undergrads. She's majoring in E.E.



Modern front decorates former factory building. School occupies two acres now but plans to add seven acres. With graduate school, enrollment totals 6,000.

THE Corporation Board (trustees) of Polytechnic recently accepted a 10-year program for Polytechnic's evolution into a technological university. Sparkplug of the move was Polytechnic president Ernst Weber (extreme right, below).

Weber is an educator with a deep concern over one of the fundamental difficulties of our times—keeping up meaningfully with modern technological progress. "We must create a sufficient number of real educational centers," he says, "that bridge the two cultures portrayed by C. P. Snow and that actively support the psycho-social evolution stressed by Julian Huxley."

Polytechnic is noteworthy for devoting 25 percent of the total course

Long a faculty member and now a Corporation member, Dr. Herman F. Mark pioneered polymer (plastics) chemistry. Here he is with his final graduate student, Ronald Gumbs.



work to the humanities. It is now taking applications for the fall of '66 by students seeking B.Sc. degrees in the humanities or social sciences.

Another curricular innovation just begun—a premed program—stems from Polytechnic's rare ability to offer future M.D.'s a heavy chemical and math orientation. It's a

Research associate Lawrence Levey is an expert in the field of electrophyscis.

program medical schools warmly applaud, especially for those planning to go into medical research.

Besides chemistry and such physics fields as X-ray crystallography, Polytechnic excels in mechanical and electrical engineering. And it is making a fast start in a new and rapidly growing field—aerospace engineering.

President Ernst Weber received Ph.D. and D.Sc. degrees from U. of Vienna.





Dr. Eleanor Leacock, a noted anthropologist, is a member of History and Economics Department. Polytechnic faculty has 250 full-time members and 175 adjunct members.



Science Digest-November, 1965

Most Polytechnic undergraduate students come from the New York metropolitan area (where the institute is the leading school of its kind). But a drive is on to recruit qualified men and women from throughout the nation and abroad. And at the graduate level, students come from 18 countries.

The Graduate Center, 27 miles from downtown Brooklyn on Long Island, houses many of Polytechnic's major facilities—a rocket propulsion lab, high-power microwave lab, microwave antenna range and new aerospace research lab. The location reflects the recognition by the institute that part-time graduate students nationally outnumber full-time ones. For scientists and engineers working in the large industrial complex of Long Island, the site is ideal.

Much of Polytechnic's research is conducted here. Brooklyn, however, is headquarters for the school's famous Polymer Research Institute, started by Dr. Mark. It is now headed by Dr. Charles G. Overberger, who as Dean of Sciences, also directs one of Polytechnic's three new academic divisions. The others: engineering, humanities.

As it becomes a university-type institution, Polytechnic is striving to produce a special mixture for its students. President Weber calls it "an environment that bridges the worlds of pure rationality and of imaginative contemplation."

This is the second in a series on America's top science schools.





Handball is popular. The school actively pursues ten intercollegate sports.



Coed classes at Polytechnic have created a new atmosphere in the once all-male center of science and engineering. Most girls who qualify for admission are outstanding.





Undergraduates in unified honors program are able to conduct own research.

Polytechnic has frat houses like Pi Kappa Phi, also hotel dorms, residences.

### PLEASE EXPLAIN



"Offhand, I'd say he has some kind of bug."

# All about 'bugs'

## What is the difference between bacteria, microbes, germs and viruses?

Bacteria are a group of one-celled organisms which are grouped by biologists under the heading "Schizomycetes." The bacterial cell has a wall, rather like those of ordinary plant cells, and lacks chlorophyll. For this reason, the bacteria are often lumped together with other chlorophyll-l a c k i n g plants and considered to be among the "fungi."

Bacteria are distinguished from other plant cells by being extremely small. In fact, they include the smallest cells that exist. In addition, they don't have a distinct nucleus, but rather have nuclear material scattered through the cell. For this reason, they are sometimes lumped together with simple plant cells called the "blue-green algae," which also have scattered nuclear material, but which possess chlorophyll in addition.

It is becoming more and more common to group bacteria with other, larger, one-celled creatures, to form a class of creatures that are considered neither plants nor animals. These make up a third kingdom of life, the "protista." Some bacteria are "pathogenic," which means they cause disease. Most types, however, do not and are, indeed, often very useful. The fertility of the soil, for instance, depends to a large extent on the activity of soil-dwelling bacteria.

A "microbe" is, properly-speaking, any form of microscopic life, for it comes from Greek words meaning "small life." The expression "germ" is more general still, for it means any small bit of life even if it is part of a larger organism. For instance, that portion of a seed that contains the actual living cells is the germ; thus we speak of "wheat germ." Again, the egg and sperm, which carry the tiny sparks of life that will eventually flower into a complete organism, are called the "germ cells."

In common practice, however, both microbe and germ are used as synonyms for bacteria and, indeed, are applied particularly to diseasecausing bacteria.

The word "virus" is from the Latin, meaning "poison." This dates back to the time when biologists did not know exactly what a virus was, but knew that certain preparations contained something that caused disease.

The virus differs from the bacteria and from all other organisms in not being composed of cells. It is much smaller than a cell and is only the size of a large molecule. It is made up of a coil of nucleic acid surrounded by a coat of protein. In this, it resembles the chromosomes of a cell, so that one might almost

regard a virus as a "chromosome on the loose."

The chromosomes control the chemistry of the cell; and the virus, once it gets inside a cell, sets up a counter-control of its own. Usually it can bend the chemistry of the cell to its own purposes, turning all the cell machinery to the task of forming more virus. The cell is often killed in the process.

Viruses, unlike bacteria, lack the capacity for independent life. They can multiply only within cells. All are parasitic. The damage they do may be unnoticeable in some cases; but in other cases, serious diseases are produced.—Isaac Asimov

# Won't the low gravity of the moon enable astronauts to walk and run much faster than they do on earth?

No, they will be slowed down as much as 80 percent, according to Professor Rodolfo Margaria from the Institute of Human Physiology, U. of Milan, Italy. When we walk, we push almost straight upward with our legs, then let ourselves fall forward. Since the force of gravity on the moon is only about one-sixth what it is on earth, we will fall only one-sixth as fast, and therefore walk one-sixth as fast. Instead of walking three miles per hour, we will walk only one-half mile per hour.

Okay, so let's run. When we run, we still bob up and down a little as in walking. However, we push in a more horizontal direction. The net result is that we will be able to run

faster than we will be able to walk, but won't be able to run as fast as we do on earth. Six miles per hour will be tops, compared to more than 20 miles per hour possible on earth.

Because of low "g" we can then shift into a third gear we don't have on earth—jumping. If we give a stronger horizontal push to make ourselves go faster, we will just skid. It would be like gunning the engine on a snowy morning. Combining a stronger horizontal push with a stronger vertical push will make us go faster, and at the same time send us bounding from the ground. We should be able to make as much speed jumping on the moon as we do running on earth. But it will be much easier, whichever way we travel, by walking, running or jumping. We'll make low speed, but good mileage.—B.F.

## What causes hiccups? Do doctors know a treatment to cure them?

A hiccup results from an irritation or inflammation of the phrenic nerve—running from the back of the neck to the top of the spinal



This new regular feature of Science Digest will attempt to answer questions about the how's and why's of science. Send your question to Please Explain, Science Digest, 1775 Broadway, New York, New York, 10019.

cord. The nerve governs the diaphragm, sheetlike muscle between the chest and abdomen that regulates the rhythm of inhalation and exhalation.

Hiccups may begin with difficulty in the diaphragm—caused by appendicitis, sleeping sickness, kidney trouble or other conditions. The irritation may start along the course of the phrenic nerve or the neck region of the spinal cord, or may have psychological causes.

An assortment of cures are advocated: Holding your breath, having someone scare you, tickling your nose with a feather, drinking water from the far side of a glass while spinning your body. Yet no treatment works consistently on those hiccuping.

One frequently beneficial cure is the "paper bag cure," where the patient covers his head with a paper bag, thereby cutting down the oxygen intake and raising the carbon dioxide level. This relaxes the nerves and muscles and may result in ending the hiccups. However, this cure, if self-administered, may be dangerous, as the lack of oxygen can induce fainting.—J.R.

### Animal **behavior** quiz



by John and Molly Daugherty

THE RATTLESNAKE will not use the deadly weapon he possesses to kill off his own kind. Though his venom could be fatal to another rattlesnake, he settles his differences according to Marquis of Queensbury

Angry rattlesnakes glide in spirals around each other until they lie parallel. Then they clasp the lower halves of their bodies and rear the upper halves straight in the air until their heads are cheek to cheek. Each snake fills his lungs with all the air he can hold and exerts all his strength to press the other's head to the ground. The winner holds the headlock a few seconds so the loser knows he's beaten and then allows him to slink away without bloodshed.

What other animals' ways do you know?

- 1. Which of these members of the animal kingdom construct elaborate air-conditioning systems?
  - a. Termites
  - b. Ants
  - c. Bees
- 2. Which fish launches underwater missiles w knock down insects for food?
  - a. Piranha
  - b. Archer
  - c. Puffer
- 3. Which animals have a pattern of communal feeding of off-spring so that any infant is treated as the off-spring of any mother and no young one goes hungry?
  - a. Sheep
  - b. Prairie dogs
  - c. Goats
- 4. What is meant by "the third eye of a

#### rattlesnake"?

- a. A special sense of smell for use in the dark
- b. An extra eye capable of seeing its prey in the dark
- c. A heat-sensing organ to direct his attack in the dark
- 5. During a shortage of meat, which animal "couldn't care less"?
  - a. Gorilla
  - b. Dog
  - c. Hyena
- 6. Which one of these mammals has teeth that continue to grow throughout life?
  - a. Kangaroo
  - b. Goat
  - c. Rat
- Legends say elephants never forget a person who injures them. What bird outdoes the elephant on this score?
  - a. Sparrow
  - b. Jackdaw
  - c. Lark
- 8. The first signs of the "pecking order" appear when a chick is about
  - a. Three days old
  - b. Three weeks old
  - c. Three months old
- 9. Which animal is quick to abandon its sick or injured?
  - a. Dolphin
  - b. Elephant
  - c. Baboon
- 10. The electric eel can pack a potential of 500 volts with a current of one ampere for short intervals. A large amount of special type muscle tissue produces millions of miniature cell batteries. These cells are connected in
  - a. Both series and parallel
  - b. Series only
  - c. Parallel only

### Answers

1—a Termites—in particular, the Macrotermes natalensis found in parts of Africa. These termites need a high temperature and a humidity close to 100 percent. Their nests may reach a height of 16 feet. Within the

termites control the humidity, oxygen, and carbon dioxide content, as well as the temperature.

Water-carrying termites descend through tunnels to the ground-water table below the nest to keep the nest air moist. Inside the walls, there are numerous air-shafts running downward to a point below the large vaulted nest. The air circulates up through the nest and is under control by other termites who widen or narrow the airshafts as needed.

In addition to heat from their own metabolism, the termites cultivate fungus gardens which give off heat inside the nest.

- 2—b Archer. This fish swims close to the surface and from underwater shoots a jet of water at any insect flying close or perched on a plant above. The jet fans out to cover the target. The archer is most accurate when his prey is vertically overhead. He fires, opens his mouth, and the insect falls into it.
- 3—b Prairie dogs. When the young one gets hungry, he nestles up to the nearest available female—wasting no time looking for his own mother. The females never refuse to nurse the strange young one. At night the young prairie dog is just as likely as not to curl up wherever he is and stay with a new family instead of returning to his mother's nest.

Many other animals—the sheep, for instance—are averse to nursing the off-spring of another of their own kind.

**4**—c A heat-sensing organ. The organ is actually a pair of dimple-like cone depressions or cavities located between the eyes. Each has a con-

centration of 150,000 heat-sensing nerve endings. These enable the snake to detect and locate his prey accurately from the heat given off by the animal.

5—a The gorilla is a vegetarian. Though the adult male is a big strong fellow weighing as much as 400 pounds and standing six feet tall, he eats honey, eggs, and the fruit from palm trees as his steady diet.

The hyena feeds chiefly on carrion. We all feed our dogs meat.

6—c Rat. In many mammals, including man, the roots of the teeth seal off after full growth. With rats and other rodents, some of the teeth stay open at the roots so growth can continue for life. If the root stays open, new material can be added. This is a help to rodents because of their continuous gnawing activities. When some of these teeth are misplaced or crooked but not worn away from gnawing, they cause real trouble for the owner.

7—b The jackdaw. If one who robs the nest of a jackdaw is caught in the act, the jackdaw makes a furious attack and is joined by the whole flock. Even the young join in. Whenever these jackdaws see the person even years later in the vicinity, they croak at him angrily. The person seems to be their life-long enemy.

**8—b** Thorleif Schelderup-Ebbe discovered the pecking order about forty years ago. The pecking order establishes a code of behavior and an order of precedence.

At about three weeks out of the shell, one little chick will take a peck at another. If the pecked doesn't peck back, he's lost. The first chick pecks a second time and a third, and if the chick is still "chicken," he'll be henpecked for life.

Every chicken who wants to get to the top has to peck his way up. But chickens fight fairly, for two or more never gang up against one chick at the same time.

**9—c** The baboon. Baboons do not help their sick or injured, but leave them to die.

Elephants stay with their sick until the sick one either gets well or dies.

Dolphins will rally around and hold an unconscious dolphin with his blow-holes above water so he can breathe until he regains consciousness.

10—a Both series and parallel. One cell produces about .1 volt. Enough of these are stacked in series (as the cells in a flashlight) to build up the high voltage. But each stack is in parallel with other similar stacks—about 140 of them—so that the small current from each stack builds up to one ampere. Thus the power output of the eel is about 500 watts.

Nerve endings of variable thicknesses run to each cell from the brain in a unique way to activate each cell at the same instant by releasing a chemical, acetycholine. The wiring scheme rivals some modern computers with delayed action units to ensure that all cells may act in unison no matter how far they are from the brain.

### Score Yourself:

8—10 right—You get the lion's share of praise.

4— 7 right—Everyone can't be top dog.

0— 3 right—Work like a beaver next time.

### COMMENT



The National Bureau of Standards uses one-gram weights to determine the accuracy of a precision scale. Metric weights are employed throughout scientific circles.

### Why not meters and kilos?

by Alan Smith

HE U.S. Constitution specifically gives to Congress the power to "fix the standard of weights and measures." On January 27th of this year, Senator Pell of Rhode Island introduced a bill calling for a threeyear study of the practicality of converting the present United States system of measurement (correctly called the English system) to the almost universally used metric system.

By late summer, a similar meas-

ure had been put before the House. At last word, both bills were being considered by the appropriate Congressional committees.

Should we change to the metric system?

It's easier to understand, less likely to provide ground for error and in every other conceivable way better than our present method of measurement. Besides, almost all of the world beyond our borders uses it, and this in itself might be reason enough.

Why, then, have we waited this

long to convert to meters and kilos?

Actually, there is nothing new about this sort of proposal. As early as 1790, nearly half century before this country had a truly uniform set of standard weights and measures. Thomas Jefferson proposed the introduction of a more practical decimal system. Now before you start saying "Aha . . . he's got his dates wrong!" let me quickly point out that this was not the metric system but merely a similar or parallel concept. However, in 1821, John Quincy Adams did advocate adoption of the metric system. And as recently as last year bill, similar to this year's, was sent before a Congressional committee. No action was taken on it.

The one great difference, however, between last year and now is that the climate for acceptance has changed considerably. Until recently, the great metric holdouts in the world were Britain and the United States. Britain has now announced that it will convert, Canada has indicated that it intends to consider the metric system and we, once again, are considering whether to consider it. In view of the world changes, it's most likely that we will follow suit.

Therefore, this seems to be a pretty good time to cut through some of the gobbledygook that frequently surrounds any metric system discussion. It's not nearly so difficult to grasp as many people seem to think and, for reasons which should become obvious, it's much more practical than the Eng-

lish system we now are using.

The metric system was devised by Gabriel Mouton, vicar of St. Paul's Church, Lyon, France, in 1690. He proposed a uniform decimal system with its basic unit derived through a geodetic survey. Our basic unit, by the way, is the yard, which was derived originally from the approximate length of a man's stride.

### A system authorized

In 1791, and on through 1795, the French National Assembly made a number of decisions based on a report submitted by the Paris Academy of Science. It incorporated the suggestions of Mouton as well as others who had followed him, and from these decisions came what we now know as the metric system.

The system derives its name from its basic linear unit, the meter. Its length corresponds to one ten-millionth of the distance along any meridian from the North Pole to the equator. In terms of our own measuring system, that's slightly more than one yard, 1.093613 yards to be precise.

Actually, the "hows" and "whys" of deriving a basic measuring unit aren't particularly important. A system could be just as effective if its basis were the average height of a four-year-old child. What is important, however, is that all of the other units be defined as simply as possible in terms of the now established basis. This is not the case in

## The outstanding feature of the metric system is its simplicity.

the English system which we use twelve inches to a foot, three feet to a yard and 1,760 yards to a mile is neither simple nor consistent.

The most outstanding feature of the metric system is its arithmetical simplicity. Since everything in it can be expressed in a decimal fashion, much of the multiplication or division can be handled by nothing more brain-wearying than moving a decimal point one way or the other. In case you haven't tried it, this is not possible with the system presently in use in this country.

The metric system works in simple multiples of ten. A decameter is ten meters; a hectometer is one hundred: and a kilometer is one thousand. Conversely, one tenth of a meter is a decimeter: one hundreth is a centimeter; and one thousandth is a millimeter. There are other prefixes for the still larger multiples or smaller sub-divisions. And the prefixes remain consistent throughout the entire system. A thousand grams (the basic units of weight) is a kilogram and a thousand liters (the basic units of capacity) is a kiloliter. A gram is a bit more than .03 ounce and a liter is slightly more than a liquid quart.

In the metric system, square (or area) measure has, in effect, two basic units. A similar double base is also presently in use in the United States. For most purposes, we speak in terms of acres unless an area is

either too large or too small for the acre to be used as a practical definition. Under these circumstances we revert to square feet or its various multiples, i.e. yards or miles. Under the metric system the practice is much the same. In terms of usage, the acre equivalent is the "are," an area corresponding to 100 square meters. If the area is either too large or too small for the "are" or "hectare" (10,000 square meters) to be used, then measurements are made in terms of square meters or multiples thereof.

Cubic measurements are all made in terms of the cubic meter, with one notable exception. When used to measure wood, the cubic meter is called the "stere." To be perfectly honest, I don't know why the cubic measure of wood requires a name change, but, as you may recall, this is not peculiar to just the metric system. Our commonly used wood measure is the "cord," which seems to have no real relationship to anything else because its dimensions are four by four by eight feet. At least, the "stere" is a cubic meter.

Needless to say, nothing is absolutely perfect. The metric system is no exception to that and there is one bug in it. I hasten to add, however, that one is still far less than all those inherent in the system we presently use. What I'm referring to is the relationship between cubic and volume measure. The basic

unit of capacity, the liter, was originally defined as 1,000 cubic centimeters. Because of the obvious impracticality of constructing a cube of water 10cm, x 10cm, x 10cm. and being able to keep it permanently in a Bureau of Standards, the liter was redefined as 1,-000 grams of water. After precise measurement, however, it was found that this is actually equal to 1000.028 cc. Hence chemists doing precision work must always remember that a milliliter is not the same as one cubic centimeter as was originally intended. It is, instead, 1.000028 cc.

As simple as it is to say we should change to the metric system, the process of doing it is quite another thing. Obvious things like road maps and road signs would have to be changed. So would speedometers, odometers, rulers, produce labels and even many tools. The latter is something any foreign car owner is already aware of, because standard U.S. wrenches won't fit his car's metric bolts.

Even something as remote to this discussion as football might very well require change. Unless the rules were modified, the 100-yd. field would become 91.44 meters and the fans might think it just a bit ridiculous to hear a team given a 9.144-meter penalty (10 yds).

By the way, and this may surprise you a bit, even though we don't commonly use the metric system in this country, it is a legal form of measurement here. Use of it was legalized in 1866 and anyone wanting to use it has the legal right to do so. Scientists, of course, do, and most, if not all, expressions of scientific measurement have their basis in metrics. As a matter of fact, since 1959, the legal Bureau of Standards definition of a yard has been 0.9144 meter, and the pound, officially an object weighing 0.45359237 kilogram.

Even your electric meter reader, whether he knows it or not, is using the metric system indirectly because the ampere (the basic unit of electric current) is derived by metric measurement.

Of course, a complete changeover from one system to the other would require time, cause considerable initial confusion, call for some form of public re-education and cost a good deal of money. Congress has proposed that up to \$25,000,000 be allocated for just the study on the practicality of a changeover.

As you can see, there is still a great deal to consider. Though the metric system is an obviously superior one and a truly international standard is much to be desired, the question remains as to whether the combined advantages outweigh the ultimate cost. Only time will provide an answer, but, in view of the present climate you might do well to start brushing up on your 10 table of multiplication.

During Hugh Downs's vacation, his column will not appear. Instead, Science Digest will publish columns by others. This month's is by a writer who specializes in scientific subjects for the "Today" show, which Hugh Downs hosts.



#### How many years?

In "Late Science News" (July '65), you state that "Mercury drifted into its own orbit around the sun 400 thousand years ago." Don't you mean 400 million?

P. Burns Chicago, Ill.

Yes.—Ed.

### Reason for grief

I am grieved by Isaac Asimov's article "Life in 1990" (Aug. '65). The world he sees is not changed, it is just an extension of the trends of today. He accepts more wars, less meaning to our social life, and complete government control of the individual.

My reason for grief is that when such predictions get publicity they are more likely to come true.

> W. J. FISHER Houston, Texas

#### Chemist Calvin

Your August issue carries a brief report in "Late Science News" on recent findings by Dr. Melvin Calvin and a team of researchers at the University of California. The item is interesting and informative, but I believe you err in calling Dr. Calvin a "Nobel Prize winning biologist."

Dr. Calvin, a distinguished member of the American Chemical Society, won the Nobel prize in Chemistry in 1961. He is Professor of Chemistry at the University of California.

Many chemists contribute to progress in other fields, including biology, but they are nonetheless members of the chemical profession.

> JAMES H. STACK, Director American Chemical Society Washington, D.C.

#### Lone defender

Having read the letters in your August and September issues denouncing Daniel Cohen's article on UFO's ("Should We Be Serious About UFO's?" June '65), I felt a reply was in order. I'm no expert on the subject, but surely it doesn't take one to reason that it is extremely unlikely these UFO's are alien spacecraft. I don't deny the existence of other [forms of] intelligent life in this universe, but surely they wouldn't go to the expense of playing hide and seek with us. They would make some attempt to contact us, friendly or otherwise. If contact is made with visitors from another world, then I can go along with flying saucers, but until then I suggest we use a little common sense.

> WILLIAM McGreehan Sidman, Pa.

### Compassion and lucidity

Ever since "Inside Psychiatry Today" first appeared in your magazine, I've meant to write you. No other reading matter on my crowded reading calendar measures up to it. Such authenticity, truth, insight and compassion. Usually, you find sound subject matter and dull writing, or you find flighty subject matter and good writing. The wedding of the two is most unusual, and the team of Flora Rheta Schreiber and Melvin Herman deserves many bouquets.

I am a theater director who teaches blind persons. I know what handicaps can mean. And I know that your two authors know, because their compassionate understanding comes

through in every line.

John S. Thompson New York, N.Y.

After listening to Flora Rheta Schreiber on the radio the other night speaking on the subject of LSD, I went out and bought your August issue in which she and Melvin Herman have a column on the same subject.

The column was extremely interesting to a layman. You should be congratulated for having someone like Miss Schreiber, who expresses herself so lucidly and well, writing for you.

LILLIAN FIAKER New York, N.Y.

### Boy, girl; girl, boy

With regard to question 4 of the quiz at the end of your article "How chance affects your life" (Aug. '65), author Gordon S. Fay states:

"An acquaintance tells you, 'I have two children. One of them is a boy.' What is the probability that the other child is a boy— $\frac{1}{2}$  or  $\frac{1}{3}$ ?" The answer states  $\frac{1}{3}$  and explains: "The possible orders of birth are important here and there are three possible combinations: (1) older boy, younger boy; (2) older boy, younger girl; (3) older girl, younger boy. There are three possibilities, but only one (Number 1) is the possibility that the other child is a boy, also. So, one out of three, or  $\frac{1}{3}$ ."

I wish to submit that the older boy and younger boy combination can occur in two ways. The first is for the boy not mentioned to be older and the second is for the boy not mentioned to be younger, just as the girl could be younger or older. To me this seems to prove the ½ answer.

PAUL O. WINTERS Anaheim, Calif.

Question 4 fails to state what method the man used to determine that he would say, "One child is a boy." It is probable that the man said to himself, "If I have two boys, I naturally will say 'One child is a boy.' If I have two girls I will say, 'One child is a girl,' If I have a boy and a girl, I will flip a coin to decide which to say." It is easy to see that the probability of the other child's being a boy is \( \frac{1}{2} \), because in each of the four possible cases—BB, BG, GB, GG—the man makes a statement and in \( \frac{1}{2} \) the cases both children have the same sex.

DEAN G. HUFFMAN Columbus, Ohio

### The author replies

The argument advanced by many readers for an answer of ½ for problem four is invalid. (Continued)

This line of reasoning assumes that the possibilities in order of birth are, say, (a) Tom, Joe; (b) Joe, Tom; (c) Tom, Sue; (d) Sue, Tom; or that possibility one really consists of two possibilities, (a) and (b).

At this point, I'll define what is meant by the probability that an event will occur: If an event can happen in x ways and fail to happen in y ways and each of these ways is equally likely, then the probability

that it will occur is  $\frac{x}{x+y}$ 

The event in question here is not possible order of birth but is the existence of two sons. Therefore, (a) and (b) are merely two different ways of saying the same thing, namely the one possibility of "older boy,

younger boy."

It will be noted that (c) Tom, Sue and (d) Sue, Tom do not state a common way in which the event can fail to happen. Tom, Sue means "older boy, younger girl" while "Sue, Tom" means "older girl, younger boy". There is, therefore, only one way in which the event in question can occur and two ways in which it can fail to occur. This makes a total of three, of which only one represents two boys, giving an answer of 1/3.

Mr. Huffman has done some reading on an interesting aspect of the problem, but he fails to mention the all important "whether" of the problem. This is whether the parent presenting it is a member of a group randomly selected from (a) all couples who have two children, at least one of whom is a boy; or from (b) all couples having two children.

The problem is usually presented something like this: "A man has two children. One is a boy. . . . " What often happens is that it is not clearly indicated to which group the parent belongs. Therefore, there is an ambiguity in the problem statement. Mr. Huffman's man belongs to group (b).

What I tried to do was dispel the ambiguity without getting involved in probability terminology. So I said "An acquaintance tells you. . . ." as an indication that the parent is a casual acquaintance who could be regarded as a "random selection"

from group (a).

As can be gathered from Mr. Huffman's letter, a "random selection" from group (b), on the other hand, has to be ready to go through some pretty knowledgeable hankypanky in order to always set up the same statement so that the answer will come out 1/2. Most everyday acquaintances would not be this devious, I hope. Mr. Huffman errs when he says that "it is probable" that the parent would follow the set pattern he describes. For one thing, parents don't usually toss a coin before deciding what they are going to say about their children—as desirable as this might be. In addition, a parent selected from this group by random procedure would have to follow the pattern outlined by Mr. Huffman, in order to lead into the problem statement so that the answer would be 1/2. If you have an acquaintance for whom the answer could be 1/2, better watch him. "Such men are dangerous...."

I'm delighted that Science Digest has such a lively and inquiring au-

dience.

GORDON S. FAY Tarzana, California



Central Press

### Oil, ahoy!

ooking like a floating collection of telephone poles, "Sea Gem" arrives from France in Britain (above). The odd craft is the first drilling platform to be used by British Petroleum in its search for gas and oil in the North Sea.

The pole-like objects are the ten self-elevating legs that will support the 5,600 ton platform on the sea bed. "Sea Gem" is 247 feet long and 90 feet wide. It will be capable of drilling to depths of about 12,000 feet.

Shortly after the platform's arrival the drilling rig and equipment were placed aboard and it was towed to its first drilling location.

### In this issue . . .



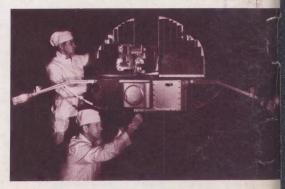
When one primate primps another, the purpose may be social ingratiation as much as hygiene. For a report on a new book detailing the fascinating ways of primates, turn to page 29.



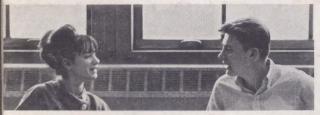
When serpents fight, do they bite each other or not? Believe it or not, they don't. For an account of how they do fight and a 10-question quiz on animal behavior. please turn to page 87.



What was in the minds of the rioters who recently left this trail of destruction in Los Angeles? What is it that leads people to violence? An exclusive psychiatric analysis of the factors involved in such situations starts on page 18.



This could be some kind of centrifugal machine. Actually it is one of the latest of America's space-exploring instruments, an orbiting solar observatory. The story of several accomplishments in space exploration starts on page 15.



Women in science? At Polytechnic Institute of Brooklyn, it's the latest thing. So is aerospace engineering, a unique premed course and a plan to convert the school into a technical university. For America's Top Science Schools—II, see p. 78.



This solar flare concerns you because it alters the nature of the electricity in the air and can affect the way you feel. For the story, turn to page 50.

This is law enforcement, 1965 style. New electronic applications in New York make it possible to identify a wanted car almost instantaneously. See page 23.



Even the most carefully laid plans go awry. But the chances of success are now sharply increased by building a computer model. See page 73.

